ENERGY SURVEY FOR THE UNITED STATES DISCIPLINARY BARRACKS (USDB)

AT

FORT LEAVENWORTH, KANSAS

FINAL SUBMITTAL

ENERGY ENGINEERING ANALYSIS PROGRAM

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VOLUME 1

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INTRODUCTION

Fort Leavenworth is a government owned and operated armed forces military base located in Leavenworth, Kansas. Located within the Fort Leavenworth jurisdiction is the United States Disciplinary Barracks (USDB). The USDB is located at the northeast corner of the base. The USDB was originally constructed around 1900, and houses military inmates from all military installations across the United States and in foreign countries. The main structure, called the Castle, contains the majority of the inmates and is located within the walls at the north end of the USDB. Originally the compound included the walls and 10 buildings. Since the original construction, 10 additional buildings have been constructed within the walls of the USDB. Over the years the general use of many of the buildings has changed. Because of these changes, many buildings were remodeled to accommodate their new functions.

Purpose of this Study

The main purpose of this study was to investigate Energy Conserving Opportunities (ECO's) for energy projects. An energy conserving opportunity is any change in the existing physical construction or operating practices of the USDB that can lessen the amount of energy utilized in the form of water, electricity, fuel oil, and natural gas. Any of the individual ECO projects studied can be merged to form a larger project with discrete parts. The main funding group is the Energy Conservation Investment Program (ECIP) for projects with a construction cost exceeding $200,000, a Savings to Investment Ratio (SIR) of greater than one, and a simple payback period of less than 10 years. The second funding group is the Military Construction Army (MCA) for projects with a construction cost exceeding $200,000 and a SIR of greater than one. In addition, to qualify for the MCA funding, all of the discrete parts of the project have to have a SIR greater than one The third funding group is the Non-ECIP for projects that do not meet ECIP criterion but have an overall SIR greater than one.

Scope of this Study

The scope of this study was to survey the buildings of the USDB for energy conservation opportunities. The study was limited to a number of buildings located within the walls of the USDB. The following table displays the buildings studied by number, the approximate square footages, and the general use of each building.

Building Number	Square Footage	General Use of the Building by the USDB
450	9,200	Mental Hygiene Clinic
463	7,700	Command Group, South Gate, Visitors Room
464	6,700	Office, Barber Shop
465	34,500	Inside Barber Shop, Minimum Security
466	22,300	Minimum Security, Carpentry, Masonry
472	19,300	Vocation Printing, Education
473	12,400	Classification
474	7,800	Pope Hall
475	90,981	Rotunda, Control, Laundry Issue
475A	17,900	DOC, Investigations, Chapel
475B	11,100	Dining Facility, Chapel, Library, Band Room
475C	46,800	3-Wing, Housing Unit, Reception, ID
475D	54,400	4-Wing, Housing Unit, 4 Base
475E	91,000	Dining Facility, DLS, Gym, Mail Room, Property
475F	54,400	6-Wing, Housing Unit
475G	46,800	7-Wing, Housing Unit, Officer/Female Housing
475H	11,100	MSA, D & A Board, TDS, DMH

The locations of the various buildings displayed in the previous table are shown in figure 1.1 which is a general map of the USDB.

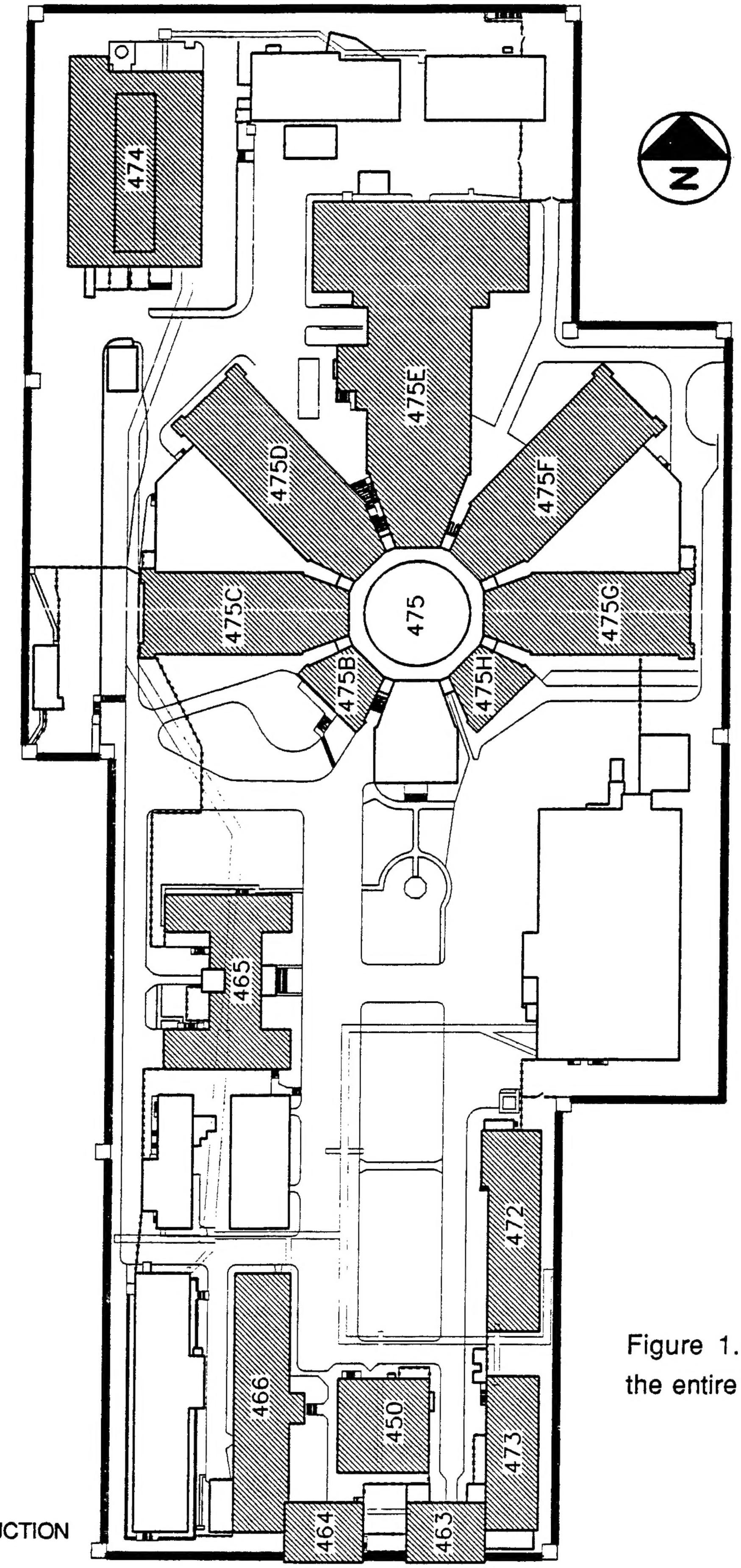

Figure 1.1 Plan view of the entire USDB.

The scope of work for this project as presented by the Corps of Engineers is located in the Appendix.

All of the ECO considered fit into three categories; architectural, mechanical, and electrical. The architectural ECO's considered were projects that changed the construction of the buildings. The mechanical ECO's were projects that changed the space air conditioning equipment and auxiliary equipment or the operation of equipment. The electrical ECO's were projects that changed the lighting or motor equipment or the operation of these systems.

Work Performed

A complete list of feasible ECO's to be studied in this project was compiled using; the list presented in the "General Scope of Work" by the Corps of Engineers, and meetings with the Director of Engineering and Housing (DEH) at Fort Leavenworth. A comprehensive list of the ECO's studied in this report is located in the ECO listing section of this Volume. Any of the ECO's listed in the "General Scope of Work" for this project that were not studied were considered not feasible. These are also shown behind the tab "ECO Listing". The ECO's were numbered relating to the discipline of the ECO, starting with an "A" for architectural, "M" for mechanical type, and "E" for electrical. The numbers of the ECO's are not consecutive because they were numbered from the "General Scope of Work", and some of the ECO's were combined or were not studied. A method for calculating the energy associated with the ECO project was determined next. Some of the energy calculations were completed using a computer simulation model of the buildings. A description of the computer simulations is located in the computer simulations section in this Volume. Other ECO's not evaluated with a computer simulation were studied with energy calculations located in each ECO section in this Volume.

The evaluation of the ECO's started with a number of field trips to the Fort Leavenworth. During each field trip, detailed field sheets were filled out containing the majority of information used to build computer models of each of the buildings to be studied for energy conservation. The field sheets contain information relating the number of people, lights and equipment located in a space and the schedule with which each occurred during a typical day. The

field sheets also encompassed the physical construction of the building, the exterior wall construction, the number and types of doors and windows, and the type and structure of the roof. The field sheets are located in Volume 5 of this report. A valuable part of the field trip was conversations with the Officers or maintenance personnel located in or in charge of the operation of the equipment and the building. All the facts about the buildings were collected and used in building the computer models and calculating the energy used for each of the ECO's.

The majority of the building information aided in developing a computer model of each of the buildings. The models were built to run a computer simulation to evaluate the energy used by the building in its existing condition and with the ECO project completed. All of the information used to build the models was taken during a field trip or was determined by an ASHRAE[1] typical average. One instance where the ASHRAE methodology was used, was building 475E, where the building at the present time is vacant waiting to be remodeled. In that case, no information could be obtained by a field trip therefore, a set of plans for the remodel was studied and averages were considered for the models. With the models built, a base load was executed to obtain an existing energy use for each building. After the base energy use for the building was determined to be reasonably accurate, the computer model was changed to reflect the construction of the ECO project.

The computer model was changed to reflect the ECO implementation and was executed to determine the energy use by the building if the ECO project were completed. The base energy use and all of the various energy uses for the ECO projects studied are located in Volumes 2, 3, and 4 of this report. Some of the ECO energy savings were not determined using the computer simulations but formula calculations. These calculations are located with each ECO section.

Existing Building Conditions

Besides a few individual cases as detailed in section ECO-A9 of this report, the buildings were in fair shape architecturally. The majority of the buildings have had insulated glass installed within the past 10 years. Although the window itself in most cases was in good shape the fit of the window in the exterior wall

was terrible. Some of the exterior doors to the buildings lacked adequate weatherstripping. Over half of the buildings studied in this report had their roofs replaced recently and good insulation was incorporated.

The general condition of mechanical heating and cooling equipment was poor. The majority of the controls that operate the equipment did not function and the controls that did function were not operating correctly to make the equipment perform. Many of the air handling units were altered to, what looked like, suffice for the present situation. When the season changes outdoors the air handling units are fixed to accommodate the new heating or cooling function required. All of the air handling units and auxiliary heating and cooling equipment should be cleaned to allow them to function better. During several of the field trips, personnel working in the spaces complained about the room uncomfortable conditions.

Electrically, all of the lighting systems functioned and were fluorescent. Only a few incandescent lights exist and their replacement was considered in ECO-E1.

Facility Maintenance

The maintenance personnel for the USDB is not a large work force. The work force is divided into the major types of maintenance to be performed; mechanical, electrical, and plumbing. In a discussion with the maintenance department, it was determined that their number of personnel is only enough to keep up with the repair work to be performed due to a failure. In many cases inmates lacking skills are utilized to work on the equipment. A large amount of energy is lost from the equipment not being maintained. An energy savings could be recovered by repairs of existing equipment, but actually, the energy savings is false because the piece of equipment should have been maintained. For the size of work force available to maintain the entire USDB, many energy saving plans are already in place. The personnel are energy minded and seem to know of many cases where a repair could save energy. A sizeable amount of pipe insulation has been done because bare steam piping was exposed. A regular routine of checking steam traps for bypassed steam is enabled when possible. The number one maintenance item to be considered is the controls for all the equipment. In almost every case the controls were in place but not functioning or calibrated, therefore overheating or cooling. A one time contract

with an outside control service to check for repair and calibration is a strong suggestion.

The notable exception, is the boiler plant where full time boiler operators are employed to take care of the equipment.

Previous Studies of the USDB

In 1980 the entire Fort Leavenworth Post was studied for energy savings. An "Integrated Energy Master Plan" was developed. This study is a detailed portion of the original master plan for energy savings and takes into account any additional energy conserving opportunities that have become evident since the submitted master plan. Since the earlier master plan dealt with Fort Leavenworth on a global scale, a detailed analysis was not presented for the part of Fort Leavenworth studied in this report, the USDB.

The ECO's that were developed in the Energy Evaluation Anticipated Program (EEAP) were studied in detail in this report. A complete and comprehensive ECO listing for the USDB as part of this report is located in this Volume under, ECO listing. Some ECO's were presented in the EEAP but are not feasible at this time due to physical construction or operating procedures. The reasons for not considering some of the ECO's established in the EEAP are defined in the same section.

ENERGY TYPES

The present utilities used at the USDB are; natural gas, fuel oil, water, and electricity. The amount of energy used by the boilers for the production of steam is converted to natural gas for the purpose of calculating energy costs in this report. All of the costs in dollars per unit of energy were calculated from information gathered from the DEH located at Fort Leavenworth.

The USDB is located in and falls under the jurisdiction of the Fort Leavenworth Military Base and receives it's electricity from the main Post feed. The electricity for the USDB is not metered separately. The Fort Leavenworth Military Base purchases electrical power from Kansas Power and Light (KPL) at a racheted rate depending on the amount of power being used at any one time by the entire base. For the purposes of this report and to simplify the calculations of dollars expended for a unit of electricity, the cost for a unit of electricity will be a set amount. The cost in dollars per KWh paid by the base was calculated to be $0.0425/KWh.

The USDB utilizes high pressure steam boilers to heat the buildings located within the walls and for the laundry located within the walls. The boilers are esentially the only equipment using natural gas. Therefore, instead of calculating a utility cost of natural gas to be used in calculating the energy usage for each building, a cost for a therms per hour (therms/hr) was calculated. A therm/hr of energy is equal to 100,000 pounds of steam/hr. The cost of steam used in this report was calculated to be $0.0534/MBTUh. The calculation for the cost of steam was:

Natural Gas Cost:	$4.00/MCF (1000 ft.^{3})
Energy per ft^3:	1,000 Btu/ft.^{3}
Boiler Efficiency:	80%
Boiler Make-up:	6%

($4.08/MCF)(1 MCF/1000 CF)(1 CF/1000 BTU)(1,000,000 BTU/MBTU)
=$4.08 / MBTU
With a global steam production efficiency of 74%, energy cost is $5.51/MBTU

Fort Leavenworth Military Base has a water treatment plant. None of the ECO's studied in this report consider the reduction in the amount of cold water received from Fort Leavenworth's water treatment system.

The energy consumption for the buildings studied as a total is shown per month in Table 1.1 and graphed in Figures 1.1 and 1.2.

MONTH	STEAM CONSUMPTION (therms)	ELECTRICITY CONSUMPTION (KWh)
January	38,691	184,945
February	35,643	165,192
March	33,399	189,410
April	10,596	168,277
May	87	163,499
June	12	238,151
July	0	268,027
August	0	260,588
September	113	195,114
October	235	155,269
November	19,550	168,693
December	46,196	173,686

Table 1.1 144,522 2,330,851

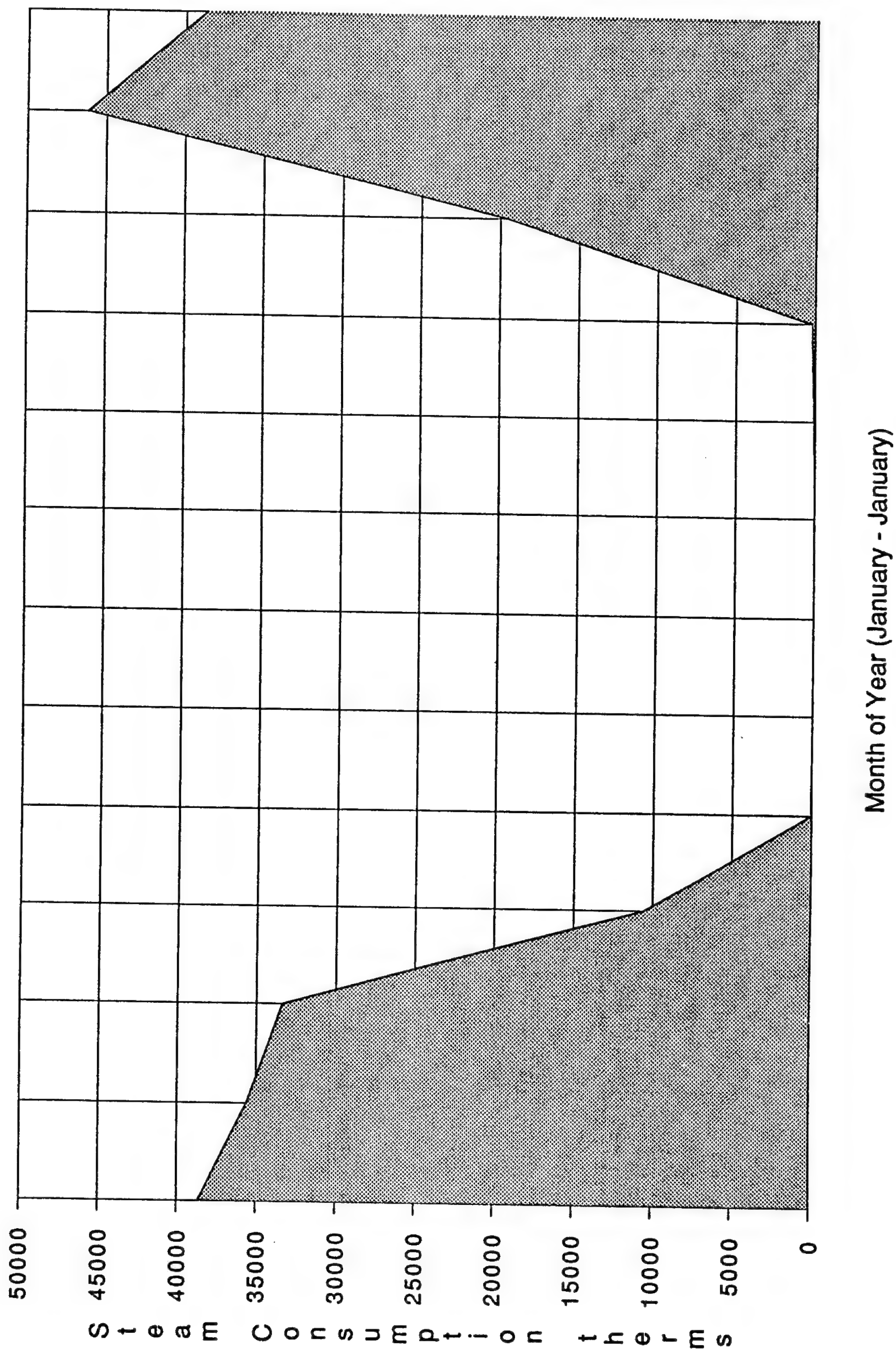
Steam Consumption therms
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Month of Year (January - January)

Figure 1.1

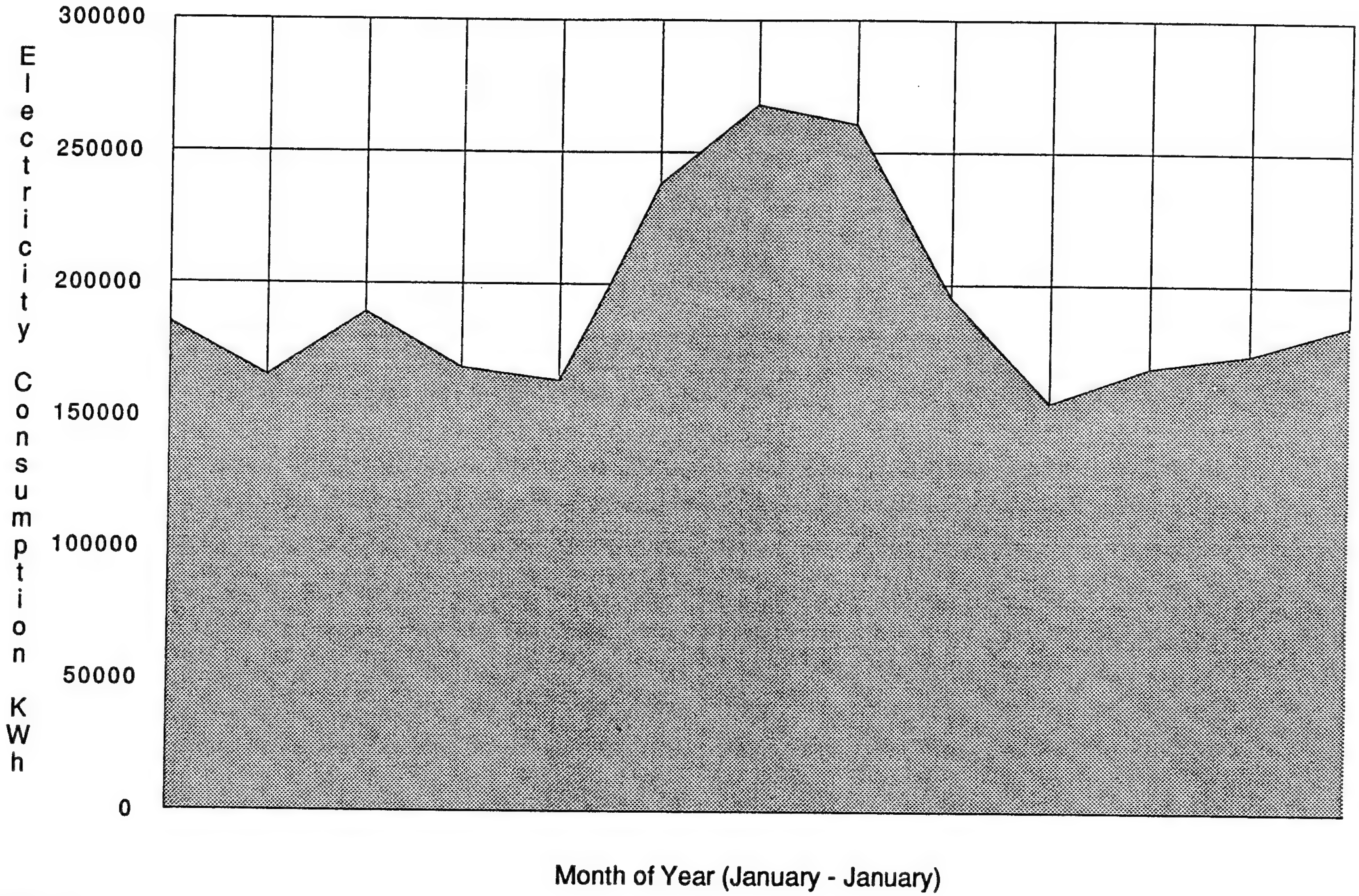
300000
250000
200000
150000
100000
50000
0
Electricity Consumption KWh
Month of Year (January - January)

Figure 1.2

COMPUTER SIMULATIONS

The computer program allows the user to physically model a building by inputting known dimensions and capacities of the building and equipment. The parameters the program uses to calculate the energy usage include; occupant load, equipment load, and weather conditions. Changes in the weather bring about changes to interior space conditions and therefore increase and decrease the energy consumed by the building for heating and cooling the space.

Energy Program

The computer program used for the majority of the energy calculations for this report, was "*Trace Ultra* ". This computer program was developed and is serviced by the Trane Company in LaCrosse, Wisconsin. The program allows the user, to model the building using the through menu driven screen displays. The program has several calculation alternatives available to the user once the model is input. The program allows the user to execute a "load" run, which calculates the largest amount of air conditioning needed to satisfy space conditions within the building. With the largest amount of air conditioning load known, a piece of HVAC equipment can be sized for the spaces. In most cases, the building equipment size was known by site observation, but where a nameplate or records were unavailable, equipment was sized for the model using the "load" calculation part of the program. Another calculation utilized in the program, was the energy simulation which calculated the energy consumed by the HVAC equipment to satisfy the space conditions on an hourly basis for an entire year. The energy simulation takes into account people and equipment moving in and out of a space and the changing conditions of the weather outside.

Program Schedules

The program utilizes schedules to know when equipment and lights are on and off, know when people are in and out of spaces, and know when the conditions of the space need to be satisfied. The schedules utilized for the models executed in this report are located in the Volume 2, Program Schedules.

Wall and Roof Types

The heat transfer to and from the interior spaces of the buildings through the exterior walls and roofs constitutes a major source of energy consumption. The heat transfer coefficient of the wall or roof, known as the "R" or "U" factor, is used to determine the amount of energy transferred through the wall or roof. The "U" factor is the inverse of the "R" factor or, $U=1/R$. The program accepts the "U" factor as input for the wall and roof coefficients and assigns it units of BTUh/Sq.Ft.•Hr.•°F. The wall and roof coefficients used for the buildings studied in this report were determined using a computer calculation available within the "*Trace Ultra*" program. All of the wall and roof coefficients used are located in Volume 2, Program "U" Values.

Computer Model Input

The computer models representing the buildings studied in the USDB were entered in the computer using a screen menu penetration scheme. The "*Trace Ultra*" program prompts the user for input on a fill in the blank basis. The program prompting the user for all of the input insures that none of the input necessary and relevant to computing the energy consumed by the building was left unentered.

Computer Model Output

The program calculates the energy consumed by the HVAC and auxiliary equipment in the building and creates an output file to be printed on the screen or a line printer. The output file contains many forms of the energy information about the building. The energy consumption for the building can be printed off in several different forms using the same values. One of the outputs allows the user to compare the overall wall, roof, and building "U" values to the ASHRAE 90 guidelines. The table, on the following page, displays the base load of the buildings in their existing condition.

BASE LOAD BUILDING SIMULATIONS		
Building Number	Electrical (KWh/yr)	Steam (therms/yr)
450	135,466	3,629
463	80,795	1,481
464	84,234	822
465	228,068	35,995
466	208,461	1,103
472	234,490	15,515
473	148,420	2,407
475	58,399	13,619
475A	146,357	12,773
475B	95,207	8,477
475C	45,478	13,472
475D	53,358	15,188
475E	611,712	21,657
475F	53,357	15,926
475G	45,481	12,853
475H	87,858	8,137
Totals	**2,317,141**	**183,054**

Table 1.1

Both are less than 1% ERROR

The computer simulation printout for the base load, reflected in the proceeding table, and all of the ECO alternate executions are located in Volumes 2, 3,.and 4.

ENERGY CONSERVATION OPPORTUNITIES LISTING

This section lists the Energy Conservation Opportunities (ECO's) that were studied as part of this report and also ECO's that were considered, but not studied because it was considered not to be feasible at this time. Along with the ECO's considered feasible, a brief description of the opportunity for energy savings is included.

Feasible ECO's

Reduce Infiltration (ECO-A1): This opportunity for energy conservation deals with the reduction in the amount of outside air infiltrating into the building. At the present time, most of the windows and doors for the buildings located in the USDB have large cracks that allow outside air to infiltrate into the building. If an excess amount of outside air is infiltrating into the space through windows and doors, an excess amount of energy is consumed.

Window Replacement (ECO-A2): This ECO studied the installation of double glazed windows anywhere single glazed windows exist. The replacement of any window with a window having a smaller "U" value decreases the amount of heat transferred to and from the space. Infiltration into the building is also usually decreased because the new windows seal the opening better.

Attic Insulation (ECO-A3): This ECO studied the addition of insulation to the attic. The additional insulation in the attic increases the "R" value for the attic and roof and decreases the "U" value. The decreased "U" value relates a decreased amount of heat transferred to and from the interior spaces of the building.

Dock Door Replacement (ECO-A4): This opportunity for energy conservation is relevant to a dock door located in building 470. The present overhead dock door needs to be replaced. The energy savings associated with a new door is derived from a reduction in heat transferred to and from interior spaces, and from decreased infiltration.

Vestibules (ECO-A5): This ECO studied the installation of vestibules for the southgate, building 463. At the present time, no vestibules exist at the entrance

or exit of this building. Especially during the heating season, the heating equipment runs non stop to try and satisfy the space conditions. Most of the time the temperature conditions are not met. The installation of a revolving door on the south entrance and a vestibule on the north will reduce the amount of outside air infiltrating into the space. The existing vestibule leading into rotunda of the castle is considered for service in ECO-A9.

Solar Window Shading (ECO-A6): This energy conserving opportunity was studied for all the buildings having cooling. The reduction in solar gain to a building from the sun through an unshaded window is beneficial during the cooling season but not during the heating season. The solar shading reflects the sunlight from heating an interior space during the cooling season, but also reduces the solar gain in the winter when it is beneficial.

Exterior Wall Insulation (ECO-A7): This ECO studied the addition of wall insulation to exterior walls. This ECO is difficult to implement in a facility of this nature. The materials necessary for the addition of wall insulation, have a reasonable resistance to damage, and have sizable material and labor costs.

Architectural Repairs (A9): This section is not an ECO, but a study of any architectural repairs for the buildings located within the USDB. Many of the items considered do not have a direct relationship to an energy savings, therefore the items listed in this section are recommended service items for the USDB.

Schedule Air Handling Equipment (ECO-M1): This ECO studied the scheduling of HVAC equipment to shut down or setback any equipment because the space is not being utilized and space temperatures do not need to be met.

Dry-Bulb Economizer Controls (ECO-M2): This ECO studied the service or addition of economizer controls and dampers to air handling units utilizing outside air at the present time. Most of the air handling units studied had or have economizer controls and dampers but do not function properly.

Service Steam Piping and Traps (ECO-M3): This ECO studied the addition of pipe insulation and steam trap replacement. Energy savings are shown in a reduction of steam use if the piping is insulated and failed traps are repaired so they do not pass steam into the condensate piping.

Exhaust Heat Recovery (ECO-M5): This ECO studied the addition of a heat recovery system for the exhausted air from the cell barracks in the castle. The location of the heat recovery system is ideal because the exhaust air is directly adjacent to the intake air to be preheated.

Insulate Ductwork (ECO-M6): This ECO studied the addition of insulation to ductwork located off of air handling units. The heat transferred from inside the ductwork to outside the ductwork is a function of the heat transfer coefficient of the ductwork material. Adding insulation to the ductwork improves the heat transfer resistance and therefore limits the amount of energy lost.

Central Plant Cooling (ECO-M10): This ECO studied the replacement of all the package air cooling equipment to a central plant chiller producing chilled water for cooling coils. In almost all of the cases where a space is being cooled a package direct expansion type of cooling is utilized. The cost per BTUh of cooling by a direct expansion type of machine is greater than the cost per BTUh of chilled water system cooling.

Castle Air System Repair (ECO-M11): This ECO studied the energy savings associated with properly heating and ventilating the cell barracks of the castle. At the present time, the air within the cell barracks is stratified and the amount of heating that is applied does not reach the bottom floors.

Reduce Steam Distribution Pressure (ECO-M12): This energy conserving opportunity deals with reducing the steam pressure needed for the USDB. The needs of the laundry are 120 psi steam, but the rest of the steam is used for heating and can be at a lower pressure. A lower pressure steam costs less to generate.

Service Condensate Return System (ECO-M14): This ECO studied the condensate system. Much of the condensate system needs to be insulated and repaired. By insulating the condensate piping, the condensate returns to the boiler plant at a higher temperature thus requiring the boilers to do less work to produce steam.

Boiler Plant Modifications (ECO-M15): This ECO studied the boiler plant and any modifications that could save energy. The energy lost during a blowdown

of a boiler can be recovered and used to preheat the boiler feedwater. Installing a boiler stack economizer is also another possible method of heat recovery off of the boilers. Preheating the combustion air to the boilers will save boiler energy. Oxygen trim control will help improve the operating efficiency of the boilers.

Convert From Steam to Hot Water (ECO-M24): This ECO studied the conversion of the existing steam system to a hot water system. The cost per BTUh for heating using steam is larger than the cost per BTUh for heating with hot water.

Convert From Steam to Cogeneration (ECO-M25): This ECO studied the conversion of the existing steam system to cogeneration. Cogeneration is possible if a large heat energy and cooling energy occur at the same time for a long period of time.

Reduce Hot Water Temperature (ECO-M26): This opportunity studied the energy savings associated with a reduction of the domestic hot water temperature used for restrooms and showers. An energy savings can be realized by lower heat losses from the water lines.

Decentralize Hot Water System (ECO-M29): This ECO studied the breakup of the domestic hot water system. At the present time several buildings are served from a hot water tank located in one building. By decentralizing the hot water system, the heat loss can be decreased.

Domestic Water Pipe Insulation (ECO-M30): This energy conserving opportunity evaluated the installation of pipe insulation on the domestic hot water piping. Energy is saved by reducing the amount of heat loss.

Heat Recovery for Laundry (ECO-M31): This ECO studied the addition of heat recovery units for the laundry wash water, dryers, and steam irons to recover water heat.

Water Heating Heatpumps (ECO-M39): This ECO studied the replacement of the existing heating and cooling equipment with a heatpump. In general heatpumps have a greater efficiency than the types of heating and cooling in the USDB buildings.

Lighting Levels (ECO-E1): This ECO studied the reduction in lighting levels in areas where the existing lighting was considered to be more than necessary.

Energy Efficient Lighting Systems (ECO-E2): This ECO studied the replacement of existing lighting systems with more efficient lighting systems of the same light level. The replacement of lights would reduce the electrical consumption of the lighting system.

Energy Efficient Motors (ECO-E3): This ECO studied the replacement of existing motors that operate fans and pumps with high efficient motors that have a higher KWh per horsepower rating. The increase in motor efficiency will decrease the amount of electrical energy used by the motors.

Non-Feasible ECO's

Prevent Air Stratification: This opportunity for energy savings is only feasible where stratification can occur. The only places that were evident of air stratification was the tall ceilings located in the cell barracks of the castle. The solution to the air stratification was studied in ECO-M11, which looked at repairing the castle's air handling systems.

Install Electrical Capacitors: This opportunity for energy savings is only feasible where a power factor less than 1.0 occurs. Based on a telephone conversation with the electrical utility for the USDB within Fort Leavenworth, no power factor charge has been charged to the USDB.

Install Flow Restrictors: This opportunity for energy savings occurs in a facility where a large amount of water is consumed by faucets in restrooms. The USDB does not have an extreme number of restrooms utilized on a regular basis. The only place where an extreme amount of water could be used, due to the number of people, would be the cell barracks where the cells are already designed for limited use.

Install Automatic Shutoff Valves: This opportunity for energy savings is similar to the flow restriction in that not an exceedingly amount of water is consumed by the restrooms within the USDB.

Laundry Heat Recovery: The opportunity for energy savings for the laundry was studied as one ECO because the laundry facility was relocated, due to a present project, into the boiler plant.

Kitchen Heat Recovery: This opportunity for energy savings was limited because the kitchen was remodeled, due to a present project. Some of the possible energy saving opportunities were considered in other global ECO's. The exhaust air and make-up air systems were retrofitted under the current project. Shutting off appliances when not being utilized is an operational consideration and not something that can be addressed in an energy study.

Reduce Outside Air Intake: This opportunity for energy savings was incorporated into ECO-A1, a reduction in infiltration. The energy savings associated with heating or cooling outside air before it's use is encompassed in reducing the amount of outside air infiltrating through window and door cracks.

Maintain Equipment: The energy associated with maintaining equipment is difficult to show in a calculation for savings of equipment repair. To recover an energy savings due to a maintenance item, the work was encompassed in various ECO's where savings could be shown.

Boiler Plant Efficiencies: The energy conserving opportunities for the boiler plant were all combined into one ECO. Many of the ECO's relied on another ECO to show a savings. For instance, the energy recovered from a boiler blowdown has to be utilized somewhere else to show a savings. Therefore the feedwater preheat was combined with the blowdown recovery.

ECO-A1

REDUCE INFILTRATION

REDUCE INFILTRATION

ENERGY CONSERVATION OPPORTUNITY: ECO-A1

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A1) analyzes the energy savings associated with reducing the amount of infiltration into the majority of the buildings located in the USDB. The implementation of this project will not change any of the existing window or door arrangements for any of the buildings.

SCOPE:

The ECO simulation (ECO-A1) adds additional weatherstripping and caulking to the existing windows and doors of the buildings to seal the cracks that are letting through outside air. The application of this project was considered for the following buildings:

Building 463	Building 475B
Building 464	Building 475C
Building 465	Building 475D
Building 466	Building 475E
Building 472	Building 475F
Building 473	Building 475G
Building 475	Building 475H
Building 475A	

MODELING TECHNIQUES:

The modeling technique used to calculate the present infiltration rate for the windows and doors was determined using an infiltration calculation method as described the ASHRAE load calculation handbook[1]. All of the exterior windows and doors for the buildings being considered are shown in the schedules for each building, Volume 3. The windows and doors were then fit into one of several categories describing the free area to the outside. The categories that the windows fit into were based on the crack width around the windows and the doors. A loose fitting window was considered to have a small or 1/4" crack. A medium fitting window was considered to have a 1/8" crack and a tight fitting window would have a 1/16" crack. With the tightness and the crack length a free area was determined. A differential pressure chart[1], was used to find the driving force, based on a wind speed of 10 mph, for the air to be infiltrated. Using the differential pressure and the free area of the crack, an amount of infiltration was determined. ASHRAE guidelines for general constructed buildings state that the infiltration total for the building is about 1.5 air changes per hour. The infiltration from

window and door cracks should be approximately 10% of the total infiltration for the buildings. The amount is infiltration calculated for the buildings considered fell into this guideline. This infiltration amount was entered into the computer simulation models to calculate the energy usage of the building. Using the same electronic spreadsheet, as shown in for each building in Volume 3, a new window and door infiltration value was determined based on the windows and doors having a tight fit, with the addition of new weatherstripping and caulking. The ECO infiltration value was entered into the same computer simulation model and executed for an energy usage. The calculation procedure for this ECO is displayed under ECO-A1, Volume 3. The difference in the energy usage before and after the implementation of the ECO was the energy savings from the ECO.

ECO IMPLEMENTATION:

The method of implementing this ECO is not difficult and could be completed by the maintenance staff with the walls of the USDB. In most cases, each of the window or door frames needs to have a bead of caulk placed between the wall and window or door frame. Almost all of the double hung windows need to have the seal between the sashes replaced with a new thicker seal with new rubber. To install new rubber seal, the upper and lower sash need to be separated and old seal removed from the track that it sits in. With the old seal removed the new seal can be fed into the channel from one of the ends. The cost estimate displays the windows in which of the buildings needs to be weatherstripped.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown in Table A1.1 in million BTU's per year savings as determined using the computer simulation model located in Volume 2.

The project cost is the construction cost as determined in this section plus 6% SIOH.

Many of the buildings show a poor energy return on the investment of weatherstripping the windows and doors because the buildings are heating only. This ECO does not show a good payback because many of the buildings are heating only building. Another reason for the poor payback is that some of the buildings have at the present time, no means of bringing in outside air for current ventilation standards of 15 CFM per person. The standard 15 CFM per person was used for the computer simulations after the windows and doors are sealed. Building 466 shows as unusually low energy savings due to the fact that the building has a base board radiant heating system and no other energy using systems.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
463	12	$49	$11,254	163.91	0.10
464	9	$42	$5,882	97.68	0.15
465	256	$1058	$65,089	11.22	1.44
466	1	$8	$19,199	4544.0	0.00
472	62	$265	$26,516	72.34	0.22
473	12	$54	$12,985	168.40	0.09
475	15	$59	$8,337	96.26	0.17
475A	93	$399	$10,074	17.83	0.89
475B	16	$65	$10,380	109.2	0.15
475C	42	$171	$33,721	137.01	0.12
475D	48	$195	$40,013	142.94	0.11
475E	53	$146	$44,628	168.33	0.11
475F	89	$365	$40,269	77.80	0.21
475G	41	$169	$34,670	146.53	0.11
475H	20	$85	$8,017	69.00	0.23

Table A1.1

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 463A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	10617.
B. SIOH	$	637.
C. DESIGN COST	$	584.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	10654.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	10654.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	16.	$ 65.	16.15	1050.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		16.	$ 65.		$ 1050.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 347.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 65.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1050.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.10
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 163.91

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 464A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	5549.
B. SIOH	$	333.
C. DESIGN COST	$	305.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	5568.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	5568.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	1.	$ 12.	11.16	134.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	11.	$ 45.	16.15	727.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		12.	$ 57.		$ 861.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 284.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 57.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 861.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.15
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 97.68

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 465A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	61405.
B. SIOH	$	3684.
C. DESIGN COST	$	3377.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	61619.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	61619.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 2.00	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 343.24	16.	$ 5492.	16.15	88696.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		16.	$ 5492.		$ 88696.

wrong

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 29270.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 5492.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 88696.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.44
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 11.22

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 466A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	18112.
B. SIOH	$	1087.
C. DESIGN COST	$	996.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	18176.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	18176.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	1.	$ 4.	16.15	65.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		1.	$ 4.		$ 65.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 21.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 4.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 65.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.00
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 4544.00

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 472A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	25015.
B. SIOH	$	1501.
C. DESIGN COST	$	1376.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	25103.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	25103.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	1.	$ 12.	11.16	134.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	82.	$ 335.	16.15	5410.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		83.	$ 347.		$ 5544.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1830.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS => 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 347.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 5544.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.22
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 72.34

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 473A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	12250.
B. SIOH	$	735.
C. DESIGN COST	$	674.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	12293.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	12293.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	1.	$ 12.	11.16	134.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	15.	$ 61.	16.15	985.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		16.	$ 73.		$ 1119.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 369.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 73.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1119.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.09
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 168.40

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475A1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	7865.
B. SIOH	$	472.
C. DESIGN COST	$	433.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	7893.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	7893.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	20.	$ 82.	16.15	1324.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		20.	$ 82.		$ 1324.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 437.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 82.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1324.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.17
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 96.26

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475AA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	9504.
B. SIOH	$	570.
C. DESIGN COST	$	523.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	9537.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	9537.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	3.	$	37.	11.16		413.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	122.	$	498.	16.15		8043.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			125.	$	535.		$	8456.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 2790.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 535.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 8456.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.89
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 17.83

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475BA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	9793.
B. SIOH	$	588.
C. DESIGN COST	$	539.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	9828.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	9828.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	0.	$	0.	11.16		0.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	22.	$	90.	16.15		1454.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			22.	$	90.		$	1454.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 480.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ______
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 90.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1454.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.15
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 109.20

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475CA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	31812.
B. SIOH	$	1909.
C. DESIGN COST	$	1750.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	31924.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	31924.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	0.	$	0.	11.16		0.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	57.	$	233.	16.15		3763.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			57.	$	233.		$	3763.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1242.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 233.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 3763.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.12
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 137.01

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475DA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	$	37748.
B. SIOH	$	2265.
C. DESIGN COST	$	2076.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	37880.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	37880.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	65.	$ 265.	16.15	4280.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		65.	$ 265.		$ 4280.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1412.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 265.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 4280.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.11
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 142.94

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475EA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	42102.
B. SIOH	$	2526.
C. DESIGN COST	$	2316.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	42250.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	42250.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	-8.	$	-100.	11.16		-1116.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	86.	$	351.	16.15		5669.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			78.	$	251.		$	4553.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1502.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 251.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 4553.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.11
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 168.33

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475FA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	37990.
B. SIOH	$	2279.
C. DESIGN COST	$	2089.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	38122.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	38122.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	120.	$ 490.	16.15	7914.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		120.	$ 490.		$ 7914.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 2612.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 490.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 7914.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.21
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 77.80

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475GA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	32708.
B. SIOH	$	1962.
C. DESIGN COST	$	1799.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	32822.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	32822.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	55.	$ 224.	16.15	3618.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		55.	$ 224.		$ 3618.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1194.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 224.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 3618.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.11
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 146.53

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475HA1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	7563.
B. SIOH	$	454.
C. DESIGN COST	$	416.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	7590.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	7590.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	27.	$ 110.	16.15	1777.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		27.	$ 110.		$ 1777.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 586.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 110.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1777.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.23
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 69.00

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 17
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463							
REMOVE OLD SEALANT INSTALL NEW SEALANT	830	FT	0.60	498	1.40	1,162	$1,660
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	830	FT	0.60	498	1.40	1,162	$1,660
WEATHERSTRIP WINDOWS	239	FT	1.40	335	2.60	621	$956
REMOVE DOOR/FRAME	2	EA			100.00	200	$200
NEW DOOR/FRAME	2	EA	420.00	840	80.00	160	$1,000
FINISH HARDWARE	2	EA	510.00	1,020	90.00	180	$1,200
PAINT	2	EA	5.00	10	35.00	70	$80
SEALANT/CAULK	34	FT	0.60	20	1.40	48	$68
MOBILIZATION	2	EA			140.00	280	$280
SUBTOTAL				$3,221		$3,883	$7,104
CONTINGENCY 10%			10%	$322	10%	$388	$710
SUBTOTAL				$3,543		$4,271	$7,814
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$124	13.0%	$555	$679
DIRECT COST				$3,667		$4,826	$8,493
OVERHEAD AND PROFIT			25%	$917	25%	$1,207	$2,124
SUBTOTAL				$4,584		$6,033	$10,617
CONSTRUCTION COST							$10,617

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 464							
REMOVE OLD SEALANT INSTALL NEW SEALANT	697	FT	0.60	418	1.40	976	$1,394
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	697	FT	0.60	418	1.40	976	$1,394
WEATHERSTRIP WINDOWS	220	FT	1.40	308	2.60	572	$880
SUBTOTAL				$1,144		$2,524	$3,668
CONTINGENCY 10%			10%	$114	10%	$252	$366
SUBTOTAL				$1,258		$2,776	$4,034
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$44	13.0%	$361	$405
DIRECT COST				$1,302		$3,137	$4,439
OVERHEAD AND PROFIT			25%	$326	25%	$784	$1,110
SUBTOTAL				$1,628		$3,921	$5,549
CONSTRUCTION COST							$5,549

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 3 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 465							
REMOVE OLD SEALANT INSTALL NEW SEALANT	5272	FT	0.60	3,163	1.40	7,381	$10,544
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	5272	FT	0.60	3,163	1.40	7,381	$10,544
WEATHERSTRIP WINDOWS	1850	FT	1.40	2,590	2.60	4,810	$7,400
WEATHERSTRIP DOORS	120	FT	1.40	168	2.60	312	$480
INSTALL NEW THRESHOLD AT DOORS (03, 05, 102, 202, AND 302)	6	EA	40.00	240	10.00	60	$300
REPLACE ENTRY (06 AND 104)							
REMOVE DOOR/FRAME	2	EA			150.00	300	$300
NEW DOOR/FRAME	2	EA	600.00	1,200	150.00	300	$1,500
FINISH HARDWARE	2	EA	510.00	1,020	90.00	180	$1,200
PAINT	2	EA	10.00	20	50.00	100	$120
SEALANT/CAULK	80	FT	0.60	48	1.40	112	$160
MOBILIZATION	2	EA			160.00	320	$320
INSTALL NEW HALLOW METAL DOOR AND FRAME (01, 08, 103, AND 301)							
REMOVE DOOR/FRAME	4	EA			100.00	400	$400
NEW DOOR/FRAME	4	EA	420.00	1,680	80.00	320	$2,000
FINISH HARDWARE	4	EA	510.00	2,040	90.00	360	$2,400
PAINT	4	EA	$5	20	35.00	140	$160
SEALANT/CAULK	136	FT	$1	82	1.40	190	$272
MOBILIZATION	4	EA			140.00	560	$560
REPLACE PAIR OF DOORS (04)							
REMOVE DOOR/FRAME	1	EA			150.00	150	$150
NEW DOOR/FRAME	1	EA	$840	840	160.00	160	$1,000
FINISH HARDWARE	1	EA	$680	680	120.00	120	$800
PAINT	1	EA	$20	20	80.00	80	$100

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE				DATE PREPARED 4/2/90			SHEET 4 OF 17
PROJECT USDB ENERGY STUDY				BASIS FOR ESTIMATE			
LOCATION FORT LEAVENWORTH, KS				X CODE A (NO DESIGN COMPLETED)			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP				CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)			
DRAWING NO. NONE			ESTIMATOR DLS			CHECKED BY TOL	

ECO-A1 **REDUCE INFILTRATION**	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 465 CONTINUED							
SEALANT/CAULK	40	FT	0.60	24	1.40	56	$80
MOBILIZATION	1	EA			160.00	160	$160
SUBTOTAL				$16,998		$23,952	$40,950
CONTINGENCY 10%			10%	$1,700	10%	$2,395	$4,095
SUBTOTAL				$18,698		$26,347	$45,045
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$654	13.0%	$3,425	$4,079
DIRECT COST				$19,352		$29,772	$49,124
OVERHEAD AND PROFIT			25%	$4,838	25%	$7,443	$12,281
SUBTOTAL				$24,190		$37,215	$61,405
CONSTRUCTION COST							$61,405

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 17

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
LOCATION FORT LEAVENWORTH, KS	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	

DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 466							
REMOVE OLD SEALANT INSTALL NEW SEALANT	1520	FT	0.60	912	1.40	2,128	$3,040
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	1520	FT	0.60	912	1.40	2,128	$3,040
WEATHERSTRIP WINDOWS	275	FT	1.40	385	2.60	715	$1,100
WEATHERSTRIP DOORS	37	FT	1.40	52	2.60	96	$148
INSTALL THRESHOLD DOOR (102)	1	EA	40.00	40	10.00	10	$50
INSTALL THRESHOLD DOOR (201)	1	EA	80.00	80	20.00	20	$100
REPLACE DOORS (101 AND 105)							
REMOVE DOOR/FRAME	2	EA			150.00	300	$300
NEW DOOR/FRAME	2	EA	550.00	1,100	100.00	200	$1,300
FINISH HARDWARE	2	EA	510.00	1,020	90.00	180	$1,200
PAINT	2	EA	8.00	16	42.00	84	$100
SEALANT/CAULK	72	FT	0.60	43	1.40	101	$144
MOBILIZATION	1	EA			140.00	140	$140
REPLACE OVERHEAD DOOR (103)							
REMOVE DOOR/TRACK	1	EA			150.00	150	$150
NEW INSULATED DOOR/TRACK	1	EA	850.00	850	250.00	250	$1,100
MOBILIZATION	1	EA			200.00	200	$200
SUBTOTAL				$5,410		$6,702	$12,112
CONTINGENCY 10%			10%	$541	10%	$670	$1,211
SUBTOTAL				$5,951		$7,372	$13,323
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$208	13.0%	$958	$1,166
DIRECT COST				$6,159		$8,330	$14,489
OVERHEAD AND PROFIT			25%	$1,540	25%	$2,083	$3,623
SUBTOTAL				$7,699		$10,413	$18,112
CONSTRUCTION COST							$18,112

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 6 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE: X CODE A (NO DESIGN COMPLETED); CODE B (PRELIMINARY DESIGN); CODE C (FINAL DESIGN); OTHER (SPECIFY)	
LOCATION: FORT LEAVENWORTH, KS		
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2745	FT	0.60	1,647	1.40	3,843	$5,490
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2745	FT	0.60	1,647	1.40	3,843	$5,490
WEATHERSTRIP WINDOWS	833	FT	1.40	1,166	2.60	2,166	$3,332
REPLACE PAIR DOORS (105)							
REMOVE DOOR/FRAME	1	EA			150.00	150	$150
NEW DOOR/FRAME	1	EA	840.00	840	160.00	160	$1,000
FINISH HARDWARE	1	EA	680.00	680	120.00	120	$800
PAINT	1	EA	20.00	20	80.00	80	$100
SEALANT/CAULK	42	FT	0.60	25	1.40	59	$84
MOBILIZATION	1	EA			160.00	160	$160
SUBTOTAL				$6,025		$10,581	$16,606
CONTINGENCY 10%			10%	$603	10%	$1,058	$1,661
SUBTOTAL				$6,628		$11,639	$18,267
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$232	13.0%	$1,513	$1,745
DIRECT COST				$6,860		$13,152	$20,012
OVERHEAD AND PROFIT			25%	$1,715	25%	$3,288	$5,003
SUBTOTAL				$8,575		$16,440	$25,015
CONSTRUCTION COST							$25,015

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CONSTRUCTION COST ESTIMATE		DATE PREPARED 4/2/90	SHEET 7 OF 17
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS		X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		___ CODE B (PRELIMINARY DESIGN) ___ CODE C (FINAL DESIGN) ___ OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR DLS		CHECKED BY TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 473							
REMOVE OLD SEALANT INSTALL NEW SEALANT	975	FT	0.60	585	1.40	1,365	$1,950
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	975	FT	0.60	585	1.40	1,365	$1,950
WEATHERSTRIP WINDOWS	347	FT	1.40	486	2.60	902	$1,388
INSTALL NEW HOLLOW METAL DOOR AND FRAME DOORS (104 AND 105)							
REMOVE DOOR/FRAME	2	EA			100.00	200	$200
NEW DOOR/FRAME	2	EA	420.00	840	80.00	160	$1,000
FINISH HARDWARE	2	EA	510.00	1,020	90.00	180	$1,200
PAINT	2	EA	5.00	10	35.00	70	$80
SEALANT/CAULK	68	FT	0.60	41	1.40	95	$136
MOBILIZATION	2	EA			140.00	280	$280
SUBTOTAL				$3,567		$4,617	$8,184
CONTINGENCY 10%			10%	$357	10%	$462	$819
SUBTOTAL				$3,924		$5,079	$9,003
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$137	13.0%	$660	$797
DIRECT COST				$4,061		$5,739	$9,800
OVERHEAD AND PROFIT			25%	$1,015	25%	$1,435	$2,450
SUBTOTAL				$5,076		$7,174	$12,250
CONSTRUCTION COST							$12,250

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 8 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475							
REMOVE OLD SEALANT INSTALL NEW SEALANT	850	FT	0.60	510	1.40	1,190	$1,700
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	850	FT	0.60	510	1.40	1,190	$1,700
WEATHERSTRIP WINDOWS	450	FT	1.40	630	2.60	1,170	$1,800
SUBTOTAL				$1,650		$3,550	$5,200
CONTINGENCY 10%			10%	$165	10%	$355	$520
SUBTOTAL				$1,815		$3,905	$5,720
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$64	13.0%	$508	$572
DIRECT COST				$1,879		$4,413	$6,292
OVERHEAD AND PROFIT			25%	$470	25%	$1,103	$1,573
SUBTOTAL				$2,349		$5,516	$7,865
CONSTRUCTION COST							$7,865

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 9 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475A							
REMOVE OLD SEALANT INSTALL NEW SEALANT	883	FT	0.60	530	1.40	1,236	$1,766
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	883	FT	0.60	530	1.40	1,236	$1,766
WEATHERSTRIP WINDOWS	674	FT	1.40	944	2.60	1,752	$2,696
ASTRAGAL DOOR (30A)	7	FT	6.80	48	1.92	13	$61
SUBTOTAL				$2,051		$4,238	$6,289
CONTINGENCY 10%			10%	$205	10%	$424	$629
SUBTOTAL				$2,256		$4,662	$6,918
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$79	13.0%	$606	$685
DIRECT COST				$2,335		$5,268	$7,603
OVERHEAD AND PROFIT			25%	$584	25%	$1,317	$1,901
SUBTOTAL				$2,919		$6,585	$9,504
CONSTRUCTION COST							$9,504

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 10 OF 17
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475B							
REMOVE OLD SEALANT INSTALL NEW SEALANT	686	FT	0.60	412	1.40	960	$1,372
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	686	FT	0.60	412	1.40	960	$1,372
WEATHERSTRIP WINDOWS	310	FT	1.40	434	2.60	806	$1,240
INSTALL NEW DOOR (101)							
REMOVE DOOR/FRAME	1	EA			100.00	100	$100
NEW DOOR/FRAME	1	EA	420.00	420	80.00	80	$500
FINISH HARDWARE	1	EA	510.00	510	90.00	90	$600
PAINT	1	EA	5.00	5	35.00	35	$40
SEALANT/CAULK	34	FT	0.60	20	1.40	48	$68
MOBILIZATION	1	EA			140.00	140	$140
INSTALL NEW DOOR (201)							
REMOVE DOOR/FRAME	1	EA			100.00	100	$100
NEW DOOR/FRAME	1	EA	336.00	336	64.00	64	$400
FINISH HARDWARE	1	EA	340.00	340	60.00	60	$400
PAINT	1	EA	5.00	5	35.00	35	$40
SEALANT/CAULK	28	FT	0.60	17	1.40	39	$56
MOBILIZATION	1	EA			120.00	120	$120
SUBTOTAL				$2,910		$3,638	$6,548
CONTINGENCY 10%			10%	$291	10%	$364	$655
SUBTOTAL				$3,201		$4,002	$7,203
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$112	13.0%	$520	$632
DIRECT COST				$3,313		$4,522	$7,835
OVERHEAD AND PROFIT			25%	$828	25%	$1,130	$1,958
SUBTOTAL				$4,141		$5,652	$9,793
CONSTRUCTION COST							$9,793

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 11 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475C							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2244	FT	0.60	1,346	1.40	3,142	$4,488
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2244	FT	0.60	1,346	1.40	3,142	$4,488
WEATHERSTRIP WINDOWS	3020	FT	1.40	4,228	2.60	7,852	$12,080
SUBTOTAL				$6,921		$14,135	$21,056
CONTINGENCY 10%			10%	$692	10%	$1,414	$2,106
SUBTOTAL				$7,613		$15,549	$23,162
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$266	13.0%	$2,021	$2,287
DIRECT COST				$7,879		$17,570	$25,449
OVERHEAD AND PROFIT			25%	$1,970	25%	$4,393	$6,363
SUBTOTAL				$9,849		$21,963	$31,812
CONSTRUCTION COST							$31,812

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 12 OF 17
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475D							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2547	FT	0.60	1,528	1.40	3,566	$5,094
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2547	FT	0.60	1,528	1.40	3,566	$5,094
WEATHERSTRIP WINDOWS	3700	FT	1.40	5,180	2.60	9,620	$14,800
SUBTOTAL				$8,236		$16,752	$24,988
CONTINGENCY 10%			10%	$824	10%	$1,675	$2,499
SUBTOTAL				$9,060		$18,427	$27,487
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$317	13.0%	$2,395	$2,712
DIRECT COST				$9,377		$20,822	$30,199
OVERHEAD AND PROFIT			25%	$2,344	25%	$5,205	$7,549
SUBTOTAL				$11,721		$26,027	$37,748
CONSTRUCTION COST							$37,748

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 13 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475E							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2800	FT	0.60	1,680	1.40	3,920	$5,600
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2800	FT	0.60	1,680	1.40	3,920	$5,600
WEATHERSTRIP WINDOWS	2407	FT	1.40	3,370	2.60	6,258	$9,628
REPLACE PAIR DOORS (40A)							
REMOVE DOOR/FRAME	1	EA			150.00	150	$150
NEW DOOR/FRAME	1	EA	840.00	840	160.00	160	$1,000
FINISH HARDWARE	1	EA	680.00	680	120.00	120	$800
PAINT	1	EA	20.00	20	80.00	80	$100
SEALANT/CAULK	42	FT	0.60	25	1.40	59	$84
MOBILIZATION	1	EA			160.00	160	$160
REPLACE PAIR DOORS (40A)							
REMOVE DOOR/FRAME	1	EA			150.00	150	$150
NEW DOOR/FRAME	1	EA	935.00	935	165.00	165	$1,100
FINISH HARDWARE	1	EA	680.00	680	120.00	120	$800
PAINT	1	EA	25.00	25	95.00	95	$120
SEALANT/CAULK	44	FT	0.60	26	1.40	62	$88
MOBILIZATION	1	EA			160.00	160	$160
REPLACE PAIR DOORS (40A)							
REMOVE DOOR/FRAME	1	EA			150.00	150	$150
NEW DOOR/FRAME	1	EA	1020.00	1,020	180.00	180	$1,200
FINISH HARDWARE	1	EA	680.00	680	120.00	120	$800
PAINT	1	EA	30.00	30	110.00	110	$140
SEALANT/CAULK	46	FT	0.60	28	1.40	64	$92
MOBILIZATION	1	EA			160.00	160	$160

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 14 OF 17

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	

DRAWING NO.	ESTIMATOR	CHECKED BY
NONE	DLS	TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475E CONTINUED							
SUBTOTAL				$11,719		$16,363	$28,082
CONTINGENCY 10%			10%	$1,172	10%	$1,636	$2,808
SUBTOTAL				$12,891		$17,999	$30,890
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$451	13.0%	$2,340	$2,791
DIRECT COST				$13,342		$20,339	$33,681
OVERHEAD AND PROFIT			25%	$3,336	25%	$5,085	$8,421
SUBTOTAL				$16,678		$25,424	$42,102
CONSTRUCTION COST							$42,102

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 15 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475F							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2587	FT	0.60	1,552	1.40	3,622	$5,174
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2587	FT	0.60	1,552	1.40	3,622	$5,174
WEATHERSTRIP WINDOWS	3700	FT	1.40	5,180	2.60	9,620	$14,800
SUBTOTAL				$8,284		$16,864	$25,148
CONTINGENCY 10%			10%	$828	10%	$1,686	$2,514
SUBTOTAL				$9,112		$18,550	$27,662
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$319	13.0%	$2,411	$2,730
DIRECT COST				$9,431		$20,961	$30,392
OVERHEAD AND PROFIT			25%	$2,358	25%	$5,240	$7,598
SUBTOTAL				$11,789		$26,201	$37,990
CONSTRUCTION COST							$37,990

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 16 OF 17
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475G							
REMOVE OLD SEALANT INSTALL NEW SEALANT	2392	FT	0.60	1,435	1.40	3,349	$4,784
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	2392	FT	0.60	1,435	1.40	3,349	$4,784
WEATHERSTRIP WINDOWS	3020	FT	1.40	4,228	2.60	7,852	$12,080
SUBTOTAL				$7,098		$14,550	$21,648
CONTINGENCY 10%			10%	$710	10%	$1,455	$2,165
SUBTOTAL				$7,808		$16,005	$23,813
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$273	13.0%	$2,081	$2,354
DIRECT COST				$8,081		$18,086	$26,167
OVERHEAD AND PROFIT			25%	$2,020	25%	$4,521	$6,541
SUBTOTAL				$10,101		$22,607	$32,708
CONSTRUCTION COST							$32,708

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 17 OF 17

PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)
	CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE C (FINAL DESIGN)
	OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
NONE	DLS	TOL

ECO-A1 REDUCE INFILTRATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475H							
REMOVE OLD SEALANT INSTALL NEW SEALANT	900	FT	0.60	540	1.40	1,260	$1,800
REMOVE OLD CAULKING/ INSTALL NEW CAULKING	900	FT	0.60	540	1.40	1,260	$1,800
WEATHERSTRIP WINDOWS	350	FT	1.40	490	2.60	910	$1,400
SUBTOTAL				$1,570		$3,430	$5,000
CONTINGENCY 10%			10%	$157	10%	$343	$500
SUBTOTAL				$1,727		$3,773	$5,500
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$60	13.0%	$490	$550
DIRECT COST				$1,787		$4,263	$6,050
OVERHEAD AND PROFIT			25%	$447	25%	$1,066	$1,513
SUBTOTAL				$2,234		$5,329	$7,563
CONSTRUCTION COST							$7,563

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PREVIOUS EDITION MAY BE USED

ECO-A2

WINDOW REPLACEMENT

DOUBLE GLAZED WINDOWS

ENERGY CONSERVATION OPPORTUNITY: ECO-A2

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A2) analyzed the energy savings associated with reducing the amount of heat transfer to and from the buildings by conduction through the glass or plastic in the windows. The implementation of this ECO will not change the number or location of any of the windows.

SCOPE:

The ECO simulation (ECO-A2) changed the windows in some of the buildings from a single paned plastic or glass to double glazed. The application of this project was considered for the following buildings:

Building 450	Building 475D
Building 465	Building 475E
Building 475	Building 475F
Building 475C	Building 475G

MODELING TECHNIQUES:

The amount of heat loss or gain through the existing windows was simulated using the *"Trace Ultra"* computer program. All of the exterior windows considered for replacement are shown in the window schedules for each building, Volume 5. The windows to be replaced have a coefficient of heat transfer (U-value) associated with the heat conduction through the window material. This U-value was entered into the computer program and used to calculate the amount of energy used by the building. The new double glazed windows have a new U-value that was used in the computer program to calculate the amount of energy used if the windows were replaced. Table A2.1 displays the U-values used for the existing single glazed windows. All of the windows being replaced will be replaced with double glazed windows with the U-values shown in the Table A2.1. If the windows were replaced the tightness of the window would increase, thus a reduction in infiltration would occur. The reduction in infiltration due to weatherstripping and caulking as calculated in ECO-A1 of this report would be valid for this ECO also. The new infiltration as calculated in ECO-A1 will be entered into the computer model for the ECO-A2 execution. The difference in the energy usage before and after the implementation of the ECO was the energy savings from the ECO.

Building Number	Existing Window Type	Existing U-value	New U-value
450	Single Plastic	0.81	0.52
465	Single Plastic	0.81	0.52
475	Single Pane Glass	0.81	0.52
475C	Single Pane Glass	0.81	0.52
475D	Single Pane Glass	0.81	0.52
475F	Single Pane Glass	0.81	0.52
475G	Single Pane Glass	0.81	0.52

Table A2.1

ECO IMPLEMENTATION:

The implementation of this ECO would not change the physical appearance of any of the buildings being considered for the window replacement. The windows that would be replaced are listed in the cost estimate in this section of the report. To remove the existing window in most cases a skilled carpenter can remove the majority of the windows from outside the building with a ladder. The entire window would be removed and a new double glazed window of the same size would be installed and weatherstripped around the casing on the inside and outside. The new double glazed windows would be the same in size, function, and operation. This ECO would need to be implemented during seasonally adequate times, possibly in the spring or fall. The replacement of the windows in the castle cell barracks would have to be scheduled so as not to have the building unsecured for any long periods of time.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table A2.2 in million BTU's per year as determined using the computer simulation model.

The project cost is the construction cost as determined in the following pages plus 6% SIOH is shown in Table A2.2.

The only buildings considered for this energy saving opportunity were buildings where the windows have not already been replaced with insulated windows. Buildings 450 and 465 are cooling buildings but have a tremendous amount of windows. The rest of the buildings considered were heating only buildings and a payback is not feasible.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
450	104	$455	$36,091	74.60	0.21
465	217	$892	$391,395	414.93	0.04
475	78	$317	$111,196	331.03	0.05
475C	161	$658	$640,908	318.52	0.05
475D	237	$967	$755,356	254.16	0.06
475F	186	$761	$755,356	323.81	0.05
475G	164	$671	$640,908	312.81	0.05

Table A2.2

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 450A2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	34048.
B. SIOH	$	2043.
C. DESIGN COST	$	1873.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	34168.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	34168.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	4.	$ 50.	11.16	558.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	100.	$ 408.	16.15	6589.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		104.	$ 458.		$ 7147.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 2359.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 458.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 7147.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.21
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 74.60

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 465A2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	369241.
B. SIOH	$	22154.
C. DESIGN COST	$	20308.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	370533.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	370533.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	1.	$ 12.	11.16	134.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	216.	$ 881.	16.15	14228.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		217.	$ 893.		$ 14362.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4739.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 893.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 14362.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.04
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 414.93

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475A2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	104902.
B. SIOH	$	6294.
C. DESIGN COST	$	5770.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	105269.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	105269.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	78.	$ 318.	16.15	5136.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		78.	$ 318.		$ 5136.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1695.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 318.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 5136.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.05
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 331.03

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475CA2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	208538.
B. SIOH	$	12512.
C. DESIGN COST	$	11470.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	209268.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	209268.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00.	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	161.	$ 657.	16.15	10611.
E. COAL	$ .00	0.	$ 0.	13:92	0.
F. TOTAL		161.	$ 657.		$ 10611.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3502.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 657.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 10611.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.05
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 318.52

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475DA2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	244911.
B. SIOH	$	14695.
C. DESIGN COST	$	13470.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	245768.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	245768.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	237.	$ 967.	16.15	15617.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		237.	$ 967.		$ 15617.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 5154.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 967.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 15617.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.06
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 254.16

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475FA2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	244911.
B. SIOH	$	14695.
C. DESIGN COST	$	13470.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	245768.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	245768.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	186.	$ 759.	16.15	12258.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		186.	$ 759.		$ 12258.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4045.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 759.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 12258.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.05
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 323.81

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475GA2
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	208538.
B. SIOH	$	12512.
C. DESIGN COST	$	11470.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	209268.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	209268.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	0.	$	0.	11.16		0.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	164.	$	669.	16.15		10804.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			164.	$	669.		$	10804.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3565.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 669.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 10804.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.05
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 312.81

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 7
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) ___ CODE B (PRELIMINARY DESIGN) ___ CODE C (FINAL DESIGN) ___ OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 450							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	555	SQ FT	37.20	20,646	4.41	2,448	$23,094
MOBILIZATION	555	SQ FT			1.00	555	$555
SUBTOTAL				$20,646		$3,003	$23,649
CONTINGENCY 10%			10%	$2,065	10%	$300	$2,365
SUBTOTAL				$22,711		$3,303	$26,014
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$795	13.0%	$429	$1,224
DIRECT COST				$23,506		$3,732	$27,238
OVERHEAD AND PROFIT			25%	$5,877	25%	$933	$6,810
SUBTOTAL				$29,383		$4,665	$34,048
CONSTRUCTION COST							$34,048

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 7
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 465							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	6019	SQ FT	37.20	223,907	4.41	26,544	$250,451
MOBILIZATION	6019	SQ FT			1.00	6,019	$6,019
SUBTOTAL				$223,907		$32,563	$256,470
CONTINGENCY 10%			10%	$22,391	10%	$3,256	$25,647
SUBTOTAL				$246,298		$35,819	$282,117
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$8,620	13.0%	$4,656	$13,276
DIRECT COST				$254,918		$40,475	$295,393
OVERHEAD AND PROFIT			25%	$63,729	25%	$10,119	$73,848
SUBTOTAL				$318,647		$50,594	$369,241
CONSTRUCTION COST							$369,241

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 3 OF 7
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	1710	SQ FT	37.20	63,612	4.41	7,541	$71,153
MOBILIZATION	1710	SQ FT			1.00	1,710	$1,710
SUBTOTAL				$63,612		$9,251	$72,863
CONTINGENCY 10%			10%	$6,361	10%	$925	$7,286
SUBTOTAL				$69,973		$10,176	$80,149
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$2,449	13.0%	$1,323	$3,772
DIRECT COST				$72,422		$11,499	$83,921
OVERHEAD AND PROFIT			25%	$18,106	25%	$2,875	$20,981
SUBTOTAL				$90,528		$14,374	$104,902
CONSTRUCTION COST							$104,902

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 7

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
NONE	DLS	TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475C							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	4323	SQ FT	27.99	121,001	4.41	19,064	$140,065
MOBILIZATION	4323	SQ FT			1.00	4,323	$4,323
SUBTOTAL				$121,001		$23,387	$144,388
CONTINGENCY 10%			10%	$12,100	10%	$2,339	$14,439
SUBTOTAL				$133,101		$25,726	$158,827
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$4,659	13.0%	$3,344	$8,003
DIRECT COST				$137,760		$29,070	$166,830
OVERHEAD AND PROFIT			25%	$34,440	25%	$7,268	$41,708
SUBTOTAL				$172,200		$36,338	$208,538
CONSTRUCTION COST							$208,538

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 7
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475D							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	5077	SQ FT	27.99	142,105	4.41	22,390	$164,495
MOBILIZATION	5077	SQ FT			1.00	5,077	$5,077
SUBTOTAL				$142,105		$27,467	$169,572
CONTINGENCY 10%			10%	$14,211	10%	$2,747	$16,958
SUBTOTAL				$156,316		$30,214	$186,530
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$5,471	13.0%	$3,928	$9,399
DIRECT COST				$161,787		$34,142	$195,929
OVERHEAD AND PROFIT			25%	$40,447	25%	$8,535	$48,982
SUBTOTAL				$202,234		$42,677	$244,911
CONSTRUCTION COST							$244,911

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1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 6 OF 7
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475F							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	5077	SQ FT	27.99	142,105	4.41	22,390	$164,495
MOBILIZATION	5077	SQ FT			1.00	5,077	$5,077
SUBTOTAL				$142,105		$27,467	$169,572
CONTINGENCY 10%			10%	$14,211	10%	$2,747	$16,958
SUBTOTAL				$156,316		$30,214	$186,530
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$5,471	13.0%	$3,928	$9,399
DIRECT COST				$161,787		$34,142	$195,929
OVERHEAD AND PROFIT			25%	$40,447	25%	$8,535	$48,982
SUBTOTAL				$202,234		$42,677	$244,911
CONSTRUCTION COST							$244,911

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 7 OF 7
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A2 WINDOW REPLACEMENT	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475G							
INSTALL ALUMINUM DOUBLE PANE INSULATED PROJECTION/FIXED WINDOWS	4323	SQ FT	27.99	121,001	4.41	19,064	$140,065
MOBILIZATION	4323	SQ FT			1.00	4,323	$4,323
SUBTOTAL				$121,001		$23,387	$144,388
CONTINGENCY 10%			10%	$12,100	10%	$2,339	$14,439
SUBTOTAL				$133,101		$25,726	$158,827
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$4,659	13.0%	$3,344	$8,003
DIRECT COST				$137,760		$29,070	$166,830
OVERHEAD AND PROFIT			25%	$34,440	25%	$7,268	$41,708
SUBTOTAL				$172,200		$36,338	$208,538
CONSTRUCTION COST							$208,538

ENG. FORM 150
1AVC-59

ECO-A3 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION BASE ENERGY (THERMS)	STEAM CONSUMPTION ECO-A3 LOAD (THERMS)	STEAM CONSUMPTION ENERGY SAVINGS (MBTU)	ELECTRIC CONSUMPTION BASE LOAD (KW)	ELECTRIC CONSUMPTION ECO-A3 LOAD (KW)	ELECTRIC CONSUMPTION ENERGY SAVINGS (MBTU)	TOTAL SAVINGS ($)
463	1,577	1,379	20	83,903	82,814	4	$127
464	2,195	1,311	88	91,802	86,441	18	$588
472	15,515	15,241	27	234,490	232,543	7	$194
475	13,619	12,203	142	58,399	58,386	0	$578
475E	21,657	21,253	40	611,712	611,617	0	$169
							$1,657

ECO-A3

ATTIC INSULATION

ATTIC INSULATION

ENERGY CONSERVATION OPPORTUNITY: ECO-A3

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A3) analyzes the energy savings associated with reducing the amount of heat transferred through the attic and roof of a building. The implementation of this ECO will not change the appearance of any of the buildings being considered.

SCOPE:

The ECO simulation (ECO-A3) adds additional attic insulation to decrease the heat transfer rate into or out of the building. The increased insulation can be added in the attics of the buildings be considered. The application of this project was considered for the buildings listed in Table A3.1.

Building Number	Insulated Section
463	Entire Attic
464	Entire Attic
472	North End of Attic
475	Entire Attic
475E	Stage Area Attic

Table A3.1

MODELING TECHNIQUES:

The heat transfer rate through the attic were simulated using the *"Trace Ultra"* computer program. The coefficient of heat transfer (U-value) for the existing roof was determined using the ASHRAE load calculation handbook[1]. The U-value for the entire roof is the sum of the U-values for each of the materials that make up the attic and roof construction. The calculation of each U-value is located in the appendix with the base load run for each building. Next, the U-value for the attic with additional insulation was determined and entered into the computer model of the building. The existing and new U-values calculated in the appendix are summarized in Table A3.2 along with a description of the method of insulation. The difference in the energy usage before and after the implementation of the ECO was the energy savings from the ECO.

Building Number	Existing U-Value	New U-Value	Insulation Description
463	0.104	0.025	Addition of 10" batt insulation in the attic between the joist.
464	0.342	0.030	Addition of 10" batt insulation in the attic between the joist.
472	0.134	0.027	Addition of 10" batt insulation in the attic between the joist.
475	0.240	0.029	Addition of 10" batt insulation in the attic under plywood between the joist.
475E	0.488	0.030	Addition of 10" batt insulation in new furring channels in the attic.

Table A3.2

ECO IMPLEMENTATION:

The implementation of this ECO in all but one of the buildings is not difficult and can be completed by the maintenance staff within the walls of the USDB. In all of the cases for the different buildings, the addition of insulation is in the attic of the buildings between the joists or roof rafters. The batt insulation, is delivered in plastic wrapped rolls. The insulation is moved to the attic unwrapped and stapled between the joists or roof rafters with a standard staple gun using 1/2" staples.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table A3.3 in million BTU's per year savings as determined using the computer simulation model.

The project cost is the construction cost as determined in this section plus 6% SIOH.

Building 475E does not show as well a payback as the other buildings because of the areas adjacent to the newly insulated section are heating only and the installation cost is relatively high.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
463	51	$462	$3484	7.05	1.71
464	80	$267	$3143	12.18	1.48
472	34	$194	$886	0.09	178.57
475	142	$578	$4868	7.96	2.03
475E	40	$169	$32316	187.69	0.09

Table A3.3

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 463A3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	3287.
B. SIOH	$	197.
C. DESIGN COST	$	181.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	3299.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	3299.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	31.	$ 386.	11.16	4308.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	20.	$ 82.	16.15	1324.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		51.	$ 468.		$ 5632.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1859.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 468.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 5632.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.71
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 7.05

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 464A3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	3143.
B. SIOH	$	189.
C. DESIGN COST	$	173.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	3155.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	3155.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	18 ~~-8.~~	$	228 ~~-100.~~	11.16		2540 ~~-1116.~~
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	88.	$	359.	16.15		5798.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			80.	$	~~259.~~ 511		$	8338 ~~4682.~~

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 2752 ~~1545.~~
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 587 ~~259.~~

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 8338 ~~4682.~~

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.64 ~~1.48~~
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 ~~12.18~~ 5.4

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 472A3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	836.
B. SIOH	$	50.
C. DESIGN COST	$	46.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	839.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	839.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ ~~2.00~~ 12.44	7.	$ ~~14.~~ 87.08	11.16	~~156.~~ 971.81
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 343.24	27.	$ ~~9267.~~ 110.16	16.15	~~149662.~~ 1779.08
E. COAL	$ 4.08 .00	0.	$ 0.	13.92	0.
F. TOTAL		34.	$ ~~9281.~~ 197.24		$ ~~149818.~~ 2750.89

Wrong

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		$	0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ ~~49440.~~ 908
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ ~~9281.~~ 197.24

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ ~~149818.~~ 2750.89

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= ~~178.57~~ 3.28
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 ~~.09~~ 4.25

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475A3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	4592.
B. SIOH	$	276.
C. DESIGN COST	$	253.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	4609.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	4609.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	0.	$	0.	11.16		0.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	142.	$	579.	16.15		9351.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			142.	$	579.		$	9351.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3086.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 579.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 9351.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.03
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 7.96

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475EA3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	30487.
B. SIOH	$	1829.
C. DESIGN COST	$	1677.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	30594.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	30594.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	40.	$ 163.	16.15	2632.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		40.	$ 163.		$ 2632.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 869.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 163.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2632.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.09
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 187.69

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 5
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A3 ATTIC INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463							
10" BATT INSULATION	2375	SQ FT	0.70	1,663	0.15	356	$2,019
MOBILIZATION	2375	SQ FT			0.10	238	$238
SUBTOTAL				$1,663		$594	$2,256
CONTINGENCY 10%			10%	$166	10%	$59	$225
SUBTOTAL				$1,829		$653	$2,481
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$64	13.0%	$85	$149
DIRECT COST				$1,893		$738	$2,630
OVERHEAD AND PROFIT			25%	$473	25%	$184	$657
SUBTOTAL				$2,366		$922	$3,287
CONSTRUCTION COST							$3,287

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 5
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A3 ATTIC INSULATION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 464							
10" BATT INSULATION	2271	SQ FT	0.70	1,590	0.15	341	$1,930
MOBILIZATION	2271	SQ FT			0.10	227	$227
SUBTOTAL				$1,590		$568	$2,157
CONTINGENCY 10%			10%	$159	10%	$57	$216
SUBTOTAL				$1,749		$625	$2,373
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$61	13.0%	$81	$142
DIRECT COST				$1,810		$706	$2,515
OVERHEAD AND PROFIT			25%	$452	25%	$176	$628
SUBTOTAL				$2,262		$882	$3,143
CONSTRUCTION COST							$3,143

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 3 OF 5
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A3 ATTIC INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472							
10" BATT INSULATION	604	SQ FT	0.70	423	0.15	91	$513
MOBILIZATION	604	SQ FT			0.10	60	$60
SUBTOTAL				$423		$151	$574
CONTINGENCY 10%			10%	$42	10%	$15	$57
SUBTOTAL				$465		$166	$631
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$16	13.0%	$22	$38
DIRECT COST				$481		$188	$669
OVERHEAD AND PROFIT			25%	$120	25%	$47	$167
SUBTOTAL				$601		$235	$836
CONSTRUCTION COST							$836

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 5
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A3 ATTIC INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475							
10" BATT INSULATION	3316	SQ FT	0.70	2,321	0.15	497	$2,819
MOBILIZATION	3316	SQ FT			0.10	332	$332
SUBTOTAL				$2,321		$829	$3,150
CONTINGENCY 10%			10%	$232	10%	$83	$315
SUBTOTAL				$2,553		$912	$3,465
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$89	13.0%	$119	$208
DIRECT COST				$2,642		$1,031	$3,673
OVERHEAD AND PROFIT			25%	$661	25%	$258	$919
SUBTOTAL				$3,303		$1,289	$4,592
CONSTRUCTION COST							$4,592

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 5
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A3 ATTIC INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475E							
7/8" FURRING CHANNEL	4575	SQ FT	0.20	915	0.65	2,974	$3,889
10" BATT INSULATION	4575	SQ FT	0.70	3,203	0.20	915	$4,118
5/8" FIRECODE GYP. BD.	4575	SQ FT	0.50	2,288	0.85	3,889	$6,176
PAINT	4575	SQ FT	0.25	1,144	0.65	2,974	$4,118
6 MIL. VAPOR BARRIER	4575	SQ FT	0.03	137	0.10	458	$595
MOBILIZATION	4575	SQ FT			0.30	1,373	$1,373
SUBTOTAL				$7,686		$12,581	$20,267
CONTINGENCY 10%			10%	$769	10%	$1,258	$2,027
SUBTOTAL				$8,455		$13,839	$22,294
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$296	13.0%	$1,799	$2,095
DIRECT COST				$8,751		$15,638	$24,389
OVERHEAD AND PROFIT			25%	$2,188	25%	$3,910	$6,098
SUBTOTAL				$10,939		$19,548	$30,487
CONSTRUCTION COST							$30,487

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PREVIOUS EDITION MAY BE USED

ECO-A4

DOCK DOOR REPLACEMENT

DOCK DOOR REPLACEMENT

ENERGY CONSERVATION OPPORTUNITY: ECO-A4

PURPOSE:

This Energy Conservation Opportunity (ECO-A4) analyzes the energy savings associated with reducing the amount of heat transferred from within building 470 to the outdoors during the winter months alone. The implementation of this project will not change the size or shape of the existing door but will not change the general appearance of the existing door to a new door.

Don't make sense

SCOPE:

The ECO simulation (ECO-A4) replaces the load dock door on the south end of the building. The replacement of the door will reduce infiltration into the building and thus reduce the amount of energy used to heat and cool the building. The method of construction for this ECO is not difficult and amounts to replacement of an overhead door.

MODELING TECHNIQUES:

The modeling technique used to calculate the heat transfer and infiltration rates for the door was determined using the U-value for the door and an infiltration calculation method as described the ASHRAE load calculation handbook[1]. The U-value of the existing door was determined from a field survey to be approximately 1.28 Btu/hr/ft^2/°F. A new rolling overhead door for the opening would have a U-value equal to 0.17 Btu/hr/ft^2/°F.

seems to good? not best fast?

The heat loss calculation due to infiltration around the casement of the door is calculated using a method described in the ASHRAE Load Calculation Manual[1]. The door was fit into one of several categories describing there amount of crack area open to the outside. The category that the door fit into was based on crack width around the door. The door was fit into the loose category with an average crack width of 1/2" and the crack factor equal to 4.46. The door is 8' by 8' in size with 4 panels, which calculates out to a crack length of 56'. The ASHRAE[1] differential pressure chart, was used to find the driving force, based on a wind speed of 10 mph, for the air to be infiltrated. Using the differential pressure and the crack free area an infiltration value for the door was determined. With the amount of unconditioned air entering the building, the infiltration can be determined. The infiltration was calculated by:

Crack Length = 56'
Differential Pressure = 0.045"
Existing Crack Width Factor = 4.46
New Crack Width Factor = 0.67

Infiltration = Q = (Crack Length)*(Differential Pressure)$^{0.5}$*(Crack Factor)
Existing Infiltration = 52.98 CFM
New Infiltration = 7.96 CFM

CRACK LENGTH STAYED THE SAME FOR THE ROLLING DOOR?

With the U-values and infiltration calculated, the total heat transfer for a year was calculated using an electronic spreadsheet and the bin method of energy analysis as shown in Table A4.2.

NOT ALLOWED

ECO IMPLEMENTATION:

To implement this ECO, the existing overhead door would have to be removed and the new overhead door, of the same size, installed in the same place. The new door would be opened with a new chain hoist on one end. The new door would be an insulated metal door with no windows.

SUMMARY:

The energy savings associated with the implementation of this ECO is shown in million BTU's in Table A4.1 as determined from the calculations as previously outlined .

The project cost is the construction cost as determined in the following pages plus 6% SIOH.

The new door as considered in the ECO section was not part of the original study but was looked at because the existing overhead door is in poor shape and could be replaced with a considerable energy savings. The USDB carpentry shop could install a new overhead door. If an outside contractor were hire for this installation, the energy savings would not pay for the door.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
470	16	$67	$870	9.70	1.67

Table A4.1

**ENERGY ANALYSIS WORKSHEET
USING
ASHRAE MODIFIED BIN METHOD**

BIN TEMP	AVG. DB TEMP	BIN TEMP BELOW 68°F	BIN HOURS PER YEAR	EXIST Q1 U=1.28 A=64	NEW Q2 U=0.17 A=64	EXIST Q3 INFILT. CFM= 52.98	NEW Q4 INFILT. CFM= 7.96	EXIST (Q1+Q3) * (BIN HRS)	NEW Q2+Q4 * (BIN HRS)
100/104	102		3						
95/99	97		41						
90/94	92		197						
85/89	87		436						
80/84	82		638						
75/79	77		788						
70/74	72		710						
65/69	67	1	717	81.92	10.88	57.48	8.64	99952	13993
60/64	62	6	681	491.52	65.28	344.90	51.82	569602	79745
55/59	57	11	587	901.12	119.68	632.32	95.00	900127	126019
50/54	52	16	584	1310.72	174.08	919.73	138.19	1302584	182363
45/49	47	21	539	1720.32	228.48	1207.15	181.37	1577906	220908
40/44	42	26	580	2129.92	282.88	1494.57	224.55	2102202	294310
35/39	37	31	678	2539.52	337.28	1781.98	267.73	2929979	410200
30/34	32	36	589	2949.12	391.68	2069.40	310.92	2955908	413830
25/29	27	41	347	3358.72	446.08	2356.82	354.10	1983291	277663
20/24	22	46	296	3768.32	500.48	2644.23	397.28	1898115	265738
15/19	17	51	153	4177.92	554.88	2931.65	440.47	1087764	152288
10/14	12	56	77	4587.52	609.28	3219.06	483.65	601107	84156
5/9	7	61	67	4997.12	663.68	3506.48	526.83	569741	79764
0/4	2	66	47	5406.72	718.08	3793.90	570.02	432429	60540

TOTAL EXISTING YEARLY LOAD IN BTU'S	19,010,707	
TOTAL NEW YEARLY LOAD IN BTU'S		2,661,518
TOTAL YEARLY LOAD DIFFERENCE IN BTU'S		16,349,189

Table A4.1

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 470A4
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	870.
B. SIOH	$	52.
C. DESIGN COST	$	48.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	873.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	873.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	22.	$ 90.	16.15	1454.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		22.	$ 90.		$ 1454.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 480.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 90.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1454.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.67
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 9.70

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 1
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A4 DOCK DOOR REPLACEMENT	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 470							
DEMOLITION	1	EA			50.00	50	$50
ROLLING DOOR/HARDWARE	1	EA	745.00	745	75.00	75	$820
CONSTRUCTION COST							$870

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PREVIOUS EDITION MAY BE USED

ECO-A5 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS ($)
	BASE ENERGY (THERMS)	ECO-A5 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-A5 LOAD (KW)	ENERGY SAVINGS (MBTU)	
463	1,577	1,453	12	83,903	83,775	0	$56
							$56

ECO-A5

VESTIBULES

VESTIBULES

ENERGY CONSERVATION OPPORTUNITY: ECO-A5

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A5) analyzes the energy savings associated with installation of vestibules on the high traffic entrances and exits of the buildings located in the USDB. The implementation of this project will change the exterior appearance of buildings being considered for vestibules.

SCOPE:

The ECO simulation (ECO-A5) adds and repairs the vestibules on the entrances and exits of building 463 (the south gate) and the castle. At the present time building 463 does not have any type of vestibules on the north or south doorways. This building acts as a entrance and exit for the majority of the personnel that operate the facility. Approximately 1,200 people work in the USDB everyday and pass through building 463 for entering and leaving. A new vestibules for the north entrance and new doors for the south entrance were considered as part of this ECO. The castle has vestibules at the present time on the two highly trafficked doors. Improvements to the function and construction of the existing castle vestibules were considered in ECO-A9.

MODELING TECHNIQUES:

The energy savings for this ECO gained by reducing the large amount of infiltration being induced into the building by the large cracks in the existing doors and the opening and closing the doors to allow people to enter and exit. The addition of a vestibule contains the outside air in a finite space reducing the amount allowed into the building. The addition of a vestibule also prevents the wind from penetrating into the interior spaces. The ASHRAE load calculation handbook[1] covers in detail how to determine the amount of outside air entering through doors with a known amount of traffic. The following data was used in calculating the existing and new infiltration rates:

Differential Pressure = 0.045"
Average Number of People Through Door per Hour = 200
Existing CFM per Door = 1100 CFM
New CFM per Door = 200 CFM
Reduction in Infiltration = 900 CFM

The base load computer run contains a large amount of infiltration and the ECO run for the buildings contains the reduced amount of infiltration.

ECO IMPLEMENTATION:

To implement this ECO the complete south door opening will be removed and a revolving door with standard door will be installed. The new doors and glass for the south opening will have bullet proof glass to be resistant of a .38 cal. fire at close range. The north door for the south gate will have a vestibule added on to the outside of the building. The addition of the vestibule will not be permanently attached to the existing building and could possibly be removed if necessary. Neither the addition of the revolving door on the south or the vestibule on the north will change the visibility or operation of the southgate. Figures A5.1 thru A5.3 show a revolving door and vestibule for this building.

SUMMARY:

Although the addition of the revolving door and vestibule may not be feasible to consider from a payback stand point due to the fact that the comfort levels of the southgate area are not being met with the existing heating cooling equipment. If the heating and cooling equipment were sized adequately for the existing load on the southgate, a return on investment due to energy savings would appear more feasible.

The energy savings associated with the implementation of this ECO is shown in Table A5.1 in million BTU's per year savings as determined using the computer simulation model.

The project cost is the construction cost as determined in the appendix plus 6% SIOH.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
463	39	$391	$88,238	341.88	0.04

Table A5.2

Building 463 South Gate

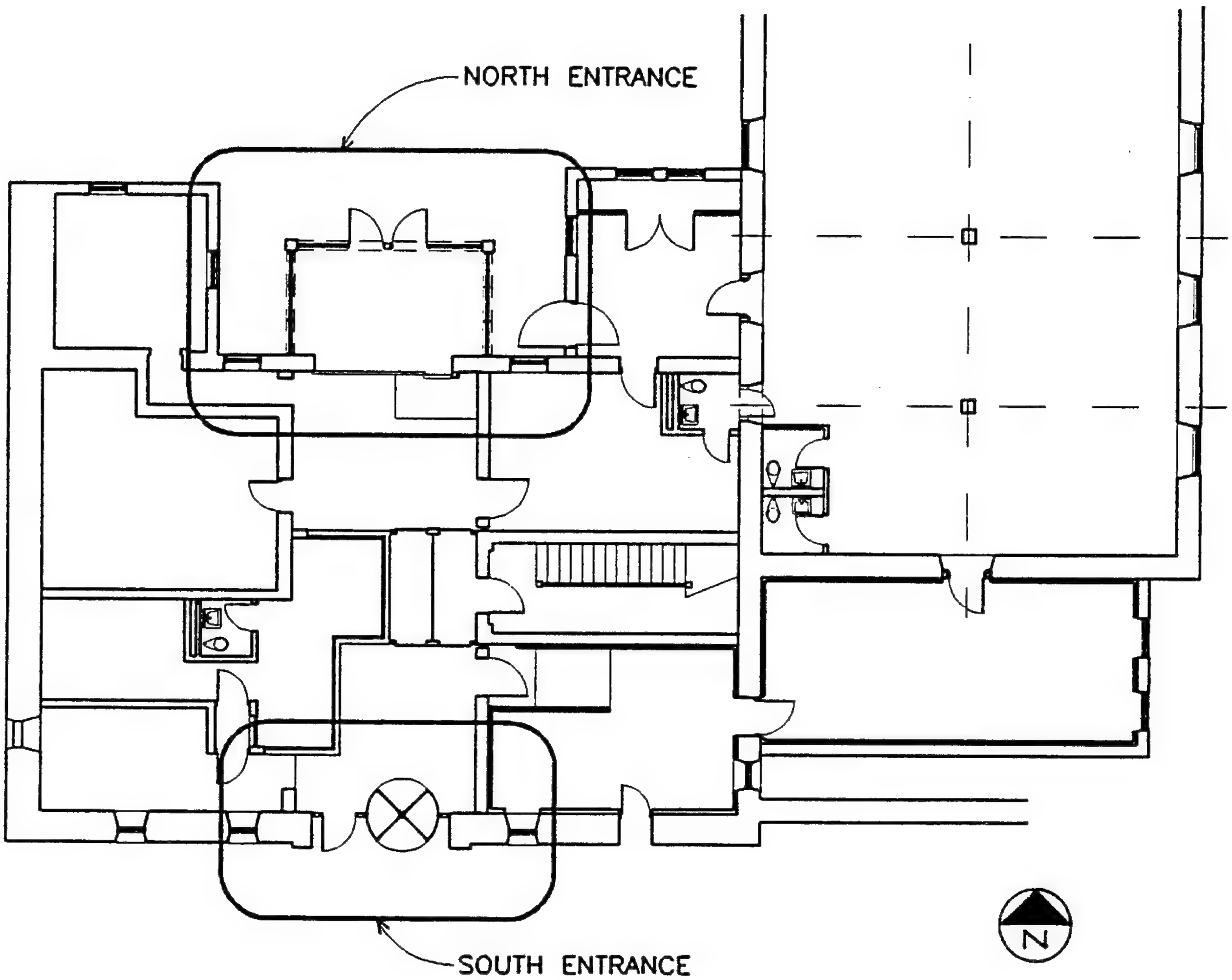


Figure A5.1

Building 463 South Gate

South Elevation

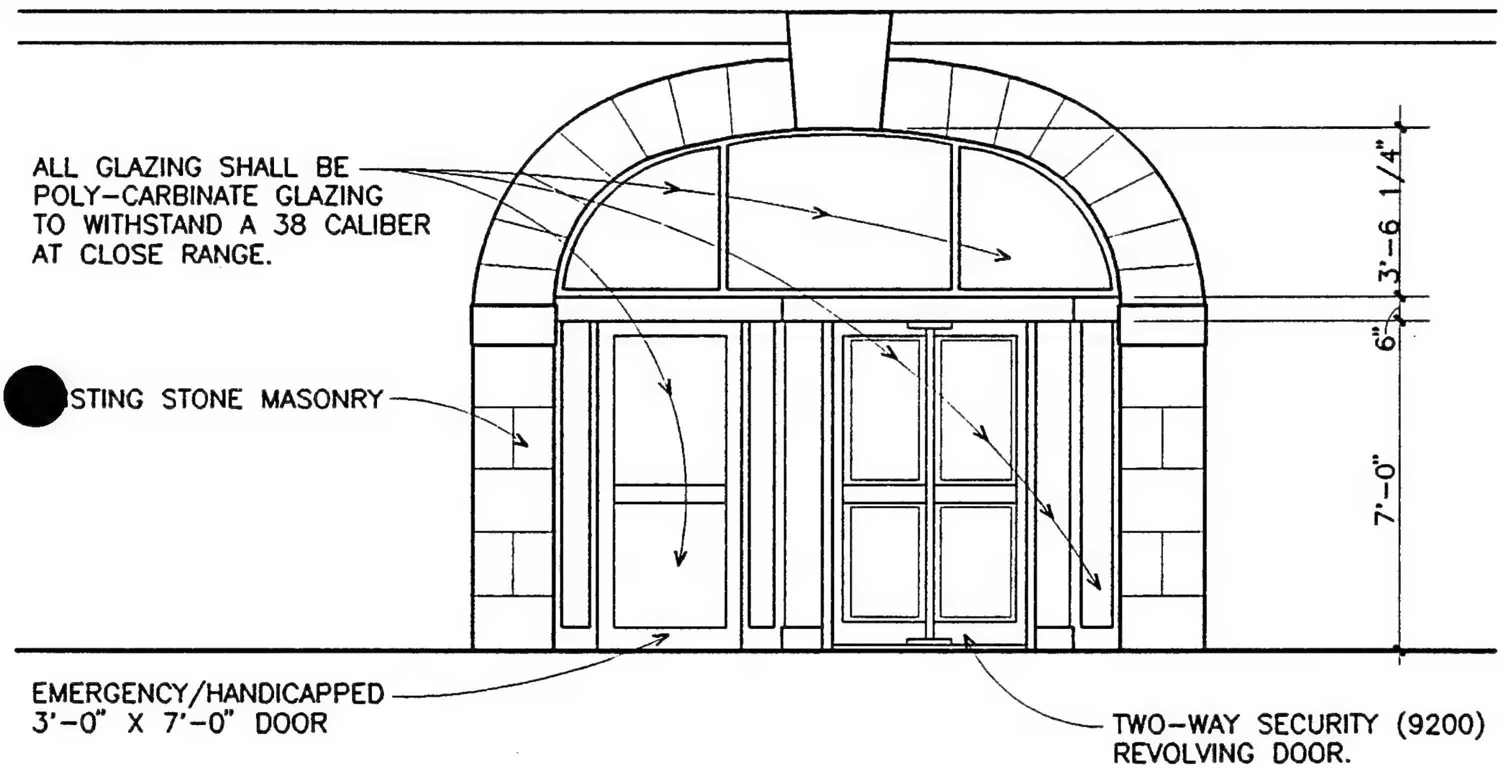


Figure A5.2

Building 463 South Gate
North Elevation

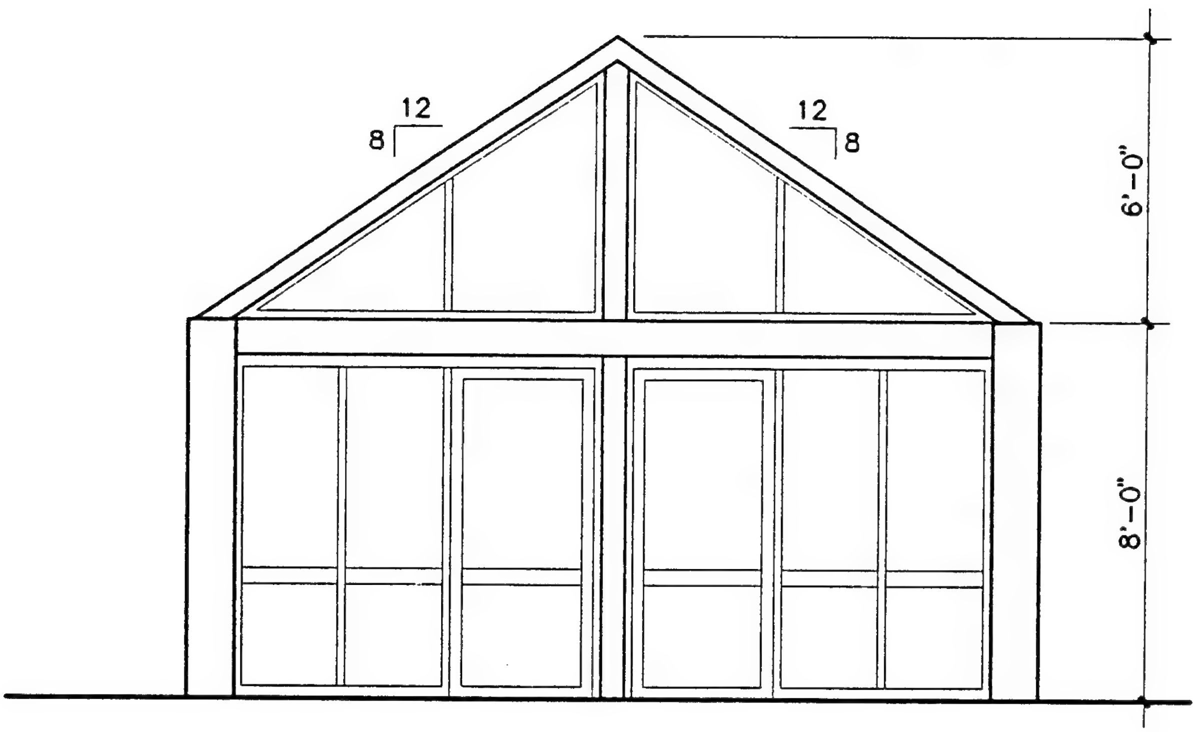


Figure A5.3

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 463A5
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	88238.
B. SIOH	$	5294.
C. DESIGN COST	$	4853.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	88547.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	88547.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	12.	$ 149.	11.16	1663.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	27.	$ 110.	16.15	1777.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		39.	$ 259.		$ 3440.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1135.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 259.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 3440.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.04
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 341.88

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A5 VESTIBULES	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463 SOUTH DOORWAY							
DEMOLITION	1	EA			500.00	500	$500
REVOLVING DOOR	1	EA	21000	21,000	2400.00	2,400	$23,400
MAGNETIC BREAKOUTS	1	EA	2400.00	2,400	200.00	200	$2,600
BATTERY BACK UP	1	EA	1100.00	1,100	200.00	200	$1,300
ENTRANCE DOOR	1	EA	4300.00	4,300	515.00	515	$4,815
POLYCARBONATE GLAZING	271	SQ FT	4.85	1,314	2.28	618	$1,932
METAL FRAME	105	FT	6.50	683	4.16	437	$1,119
SUBTOTAL				$30,797		$4,870	$35,667
CONTINGENCY 10%			10%	$3,080	10%	$487	$3,567
SUBTOTAL				$33,877		$5,357	$39,234
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$1,186	13.0%	$696	$1,882
DIRECT COST				$35,063		$6,053	$41,116
OVERHEAD AND PROFIT			25%	$8,766	25%	$1,513	$10,279
SUBTOTAL				$43,829		$7,566	$51,395
CONSTRUCTION COST							$51,395

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 2
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A5 VESTIBULES	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463 NORTH DOORWAY							
EXCAVATE/DISPOSAL/TRIM	38	FT	0.63	24	2.12	81	$105
CONC. FTG. W/REBAR	38	FT	15	570	7.25	276	$846
MOBILIZATION	38	FT			2.50	95	$95
PREP EARTH BASE	180	SQ FT			0.15	27	$27
6" CRUSHED ROCK	180	SQ FT	0.20	36	0.10	18	$54
6 MIL. VAPOR BARRIER	180	SQ FT	0.05	9	0.02	4	$13
6 X 6 - 10/10 W.W.F.	180	SQ FT	0.08	14	0.12	22	$36
3500 PSI FINISH	180	SQ FT	0.94	169	0.81	146	$315
CURING	180	SQ FT	0.05	9	0.02	4	$13
JOINTS	180	SQ FT			0.04	7	$7
MOBILIZATION	180	SQ FT			0.24	43	$43
RIGID STL. FRAME/GLASS	180	SQ FT	67.50	12,150	22.50	4,050	$16,200
MOBILIZATION	180	SQ FT			0.50	90	$90
DOOR/LAMINATED GLASS	2	EA	3200.00	6,400	550.00	1,100	$7,500
SUBTOTAL				$19,382		$5,961	$25,343
CONTINGENCY 10%			10%	$1,938	10%	$596	$2,534
SUBTOTAL				$21,320		$6,557	$27,877
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$746	13.0%	$852	$1,598
DIRECT COST				$22,066		$7,409	$29,475
OVERHEAD AND PROFIT			25%	$5,516	25%	$1,852	$7,368
SUBTOTAL				$27,582		$9,261	$36,843
CONSTRUCTION COST							$36,843

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

ECO-A6 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS ($)
	BASE ENERGY (THERMS)	ECO-A6 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-A6 LOAD (KW)	ENERGY SAVINGS (MBTU)	
450	3,629	3,403	23	135,466	131,720	13	$251
463	1,577	1,796	-22	83,903	82,425	5	($27)
464	2,195	2,352	-16	91,802	90,467	5	($7)
472	15,515	15,515	0	234,490	229,344	18	$218
473	2,407	2,609	-20	148,420	145,653	9	$35
475A	12,773	12,773	0	146,357	136,920	32	$401
475B	8,477	8,477	0	95,207	93,496	6	$73
475H	8,137	8,137	0	87,858	86,474	5	$59
							$1,003

ECO-A6

SOLAR WINDOW SHADING

SOLAR WINDOW SHADING

ENERGY CONSERVATION OPPORTUNITY: ECO-A6

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A6) analyzes the energy savings associated with reducing the amount of solar gain on the buildings with cooling with the addition of a solar shading added to the windows. The addition of the solar shading would change the appearance of the exterior window facing to the south, east, and west. The window would have a dark brown tint.

SCOPE:

The ECO simulation (ECO-A6) adds solar shading film to existing windows to lessen the amount of sunlight that is allowed to pass through the window and heat up the interior. The application of this project was considered for the following buildings:

Building 450	Building 473
Building 463	Building 475A
Building 464	Building 475B
Building 472	Building 475H

MODELING TECHNIQUES:

The present solar gain on the buildings due to the lack of exterior shading was estimated by the *"Trace Ultra"* computer program simulation of the building. All of the exterior shading coefficients for the windows on the south, east, and west surfaces of the buildings were changed in the model and then an alternate run was completed to evaluate the new energy usage. The existing and ECO shading coefficients are shown in Table A6.1 The difference in the energy usage before and after the installation of the exterior shading is the energy savings for this ECO. Both the computer simulation run for the base load and the ECO are located in the appendix.

Building Number	Existing Window Type	Existing Shading Coefficient	ECO Shading Coefficient
450	Single Glazed	0.95	0.36
463	Double Glazed	0.85	0.43
464	Double Glazed	0.85	0.43
472	Double Glazed	0.85	0.43
473	Double Glazed	0.85	0.43
475A	Double Glazed	0.85	0.43
475B	Double Glazed	0.85	0.43
475H	Double Glazed	0.85	0.43

Table A6.1

ECO IMPLEMENTATION:

The implementation of this ECO is not difficult and can be completed in a relatively short period of time. In the buildings being considered for the solar shading, a film is attached to the inside of the window. The film is held in place with a sticky backing.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table A6.2 in million BTU's per year savings as determined using the computer simulation model.

The project cost is the construction cost as determined in the appendix plus 6% SIOH.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
450	80	$498	$2001	5.00	2.96
463	-(17)	-($53)	$2056	-(73.68)	-(0.37)
464	-(11)	($26)	$1782	-(596.00)	-(0.20)
472	18	$74	$8350	37.41	0.30
473	-(11)	~~$11~~ 130	$2565	85.80	-(0.03)
475A	32	$406	$8020	20.22	0.55
475B	6	$74	$2774	37.12	0.30
475H	5	$60	$2610	42.26	0.26

Table A6.2

Some of the buildings listed in Table A6.2 show a negative energy savings, which means that the building for the energy year used more energy after the implementation of the solar shading. The reason for this is those buildings are only partially cooled. Only specific zones of the entire building are cooled and the rest of the building is heated only. The solar shading will typically increase the heating costs because the building does not experience a solar gain in the winter season to help with heating. Building 450 shows a good payback for the solar shading because of the number of windows in the building. The summer season solar gain for building 450 is large relative to the other buildings.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 450A6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	2001.
B. SIOH	$	120.
C. DESIGN COST	$	110.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	2008.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	2008.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	9.	$	112.	11.16		1250.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	71.	$	~~290.~~	~~16.15~~		~~4684.~~
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			80.	$	~~402.~~ 112		~~$~~	~~5934.~~ 1250

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ ~~1958.~~ 413
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ ~~402.~~ 112

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ ~~5934.~~ 1250

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= ~~2.96~~ 0.62
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 ~~5.00~~ 17.9

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 463A6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	2056.
B. SIOH	$	123.
C. DESIGN COST	$	113.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	2063.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	2063.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	5.	$	62.	11.16		692.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	-22.	$	-90.	16.15		-1454.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			-17.	$	-28.		$	-762.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ -251.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ -28.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ -762.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= -0.37
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 -73.68

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 464A6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1782.
B. SIOH	$	107.
C. DESIGN COST	$	98.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1788.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1788.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	5.	$	62.	11.16		692.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	-16.	$	-65.	16.15		-1050.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			-11.	$	-3.		$	-358.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ -118.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ -3.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ -358.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= -0.20
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 -596.00

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 472A6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	8350.
B. SIOH	$	501.
C. DESIGN COST	$	459.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	8379.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	8379.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	18.	$ 224.	11.16	2500.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	0.	$ 0.	16.15	0.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		18.	$ 224.		$ 2500.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 825.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 224.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2500.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.30
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 37.41

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 473A6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	2565.
B. SIOH	$	154.
C. DESIGN COST	$	141.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	2574.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	2574.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	9.	$	112.	11.16		1250.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	-20.	$	-82.	16.15		-1324.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			-11.	$	30.		$	-74.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ -24.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 30.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ -74.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= -0.03
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 85.80

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475AA6
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	8020.
B. SIOH	$	481.
C. DESIGN COST	$	441.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	8048.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	8048.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	32.	$ 398.	11.16	4442.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	0.	$ 0.	16.15	0.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		32.	$ 398.		$ 4442.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1466.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 398.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 4442.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.55
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 20.22

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 8
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 450							
SOLAR FILM	488	SQ FT	1.30	634	1.30	634	$1,269
MOBILIZATION	488	SQ FT			0.15	73	$73
SUBTOTAL				$634		$708	$1,342
CONTINGENCY 10%			10%	$63	10%	$71	$134
SUBTOTAL				$697		$779	$1,476
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$24	13.0%	$101	$125
DIRECT COST				$721		$880	$1,601
OVERHEAD AND PROFIT			25%	$180	25%	$220	$400
SUBTOTAL				$901		$1,100	$2,001
CONSTRUCTION COST							$2,001

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 8
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463							
SOLAR FILM	501	SQ FT	1.30	651	1.30	651	$1,303
MOBILIZATION	501	SQ FT			0.15	75	$75
SUBTOTAL				$651		$726	$1,378
CONTINGENCY 10%			10%	$65	10%	$73	$138
SUBTOTAL				$716		$799	$1,516
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$25	13.0%	$104	$129
DIRECT COST				$741		$903	$1,645
OVERHEAD AND PROFIT			25%	$185	25%	$226	$411
SUBTOTAL				$926		$1,129	$2,056
CONSTRUCTION COST							$2,056

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE		DATE PREPARED 4/2/90	SHEET 3 OF 8
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS		X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
DRAWING NO. NONE	ESTIMATOR DLS		CHECKED BY TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 464							
SOLAR FILM	434	SQ FT	1.30	564	1.30	564	$1,128
MOBILIZATION	434	SQ FT			0.15	65	$65
SUBTOTAL				$564		$629	$1,194
CONTINGENCY 10%			10%	$56	10%	$63	$119
SUBTOTAL				$620		$692	$1,313
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$22	13.0%	$90	$112
DIRECT COST				$642		$782	$1,425
OVERHEAD AND PROFIT			25%	$161	25%	$196	$357
SUBTOTAL				$803		$978	$1,782
CONSTRUCTION COST							$1,782

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 8
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472							
SOLAR FILM	2035	SQ FT	1.30	2,646	1.30	2,646	$5,291
MOBILIZATION	2035	SQ FT			0.15	305	$305
SUBTOTAL				$2,646		$2,951	$5,596
CONTINGENCY 10%			10%	$265	10%	$295	$560
SUBTOTAL				$2,911		$3,246	$6,156
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$102	13.0%	$422	$524
DIRECT COST				$3,013		$3,668	$6,680
OVERHEAD AND PROFIT			25%	$753	25%	$917	$1,670
SUBTOTAL				$3,766		$4,585	$8,350
CONSTRUCTION COST							$8,350

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 8
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 473							
SOLAR FILM	625	SQ FT	1.30	813	1.30	813	$1,625
MOBILIZATION	625	SQ FT			0.15	94	$94
SUBTOTAL				$813		$906	$1,719
CONTINGENCY 10%			10%	$81	10%	$91	$172
SUBTOTAL				$894		$997	$1,891
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$31	13.0%	$130	$161
DIRECT COST				$925		$1,127	$2,052
OVERHEAD AND PROFIT			25%	$231	25%	$282	$513
SUBTOTAL				$1,156		$1,409	$2,565
CONSTRUCTION COST							$2,565

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE		DATE PREPARED 4/2/90	SHEET 6 OF 8
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS		X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR DLS		CHECKED BY TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475A							
SOLAR FILM	1955	SQ FT	1.30	2,542	1.30	2,542	$5,083
MOBILIZATION	1955	SQ FT			0.15	293	$293
SUBTOTAL				$2,542		$2,835	$5,376
CONTINGENCY 10%			10%	$254	10%	$283	$537
SUBTOTAL				$2,796		$3,118	$5,913
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$98	13.0%	$405	$503
DIRECT COST				$2,894		$3,523	$6,416
OVERHEAD AND PROFIT			25%	$723	25%	$881	$1,604
SUBTOTAL				$3,617		$4,404	$8,020
CONSTRUCTION COST							$8,020

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 7 OF 8

PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	

DRAWING NO.	ESTIMATOR	CHECKED BY
NONE	DLS	TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475B							
SOLAR FILM	676	SQ FT	1.30	879	1.30	879	$1,758
MOBILIZATION	676	SQ FT			0.15	101	$101
SUBTOTAL				$879		$980	$1,859
CONTINGENCY 10%			10%	$88	10%	$98	$186
SUBTOTAL				$967		$1,078	$2,045
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$34	13.0%	$140	$174
DIRECT COST				$1,001		$1,218	$2,219
OVERHEAD AND PROFIT			25%	$250	25%	$305	$555
SUBTOTAL				$1,251		$1,523	$2,774
CONSTRUCTION COST							$2,774

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 8 OF 8
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

ECO-A6 SOLAR WINDOW SHADING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475H							
SOLAR FILM	636	SQ FT	1.30	827	1.30	827	$1,654
MOBILIZATION	636	SQ FT			0.15	95	$95
SUBTOTAL				$827		$922	$1,749
CONTINGENCY 10%			10%	$83	10%	$92	$175
SUBTOTAL				$910		$1,014	$1,924
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$32	13.0%	$132	$164
DIRECT COST				$942		$1,146	$2,088
OVERHEAD AND PROFIT			25%	$235	25%	$287	$522
SUBTOTAL				$1,177		$1,433	$2,610
CONSTRUCTION COST							$2,610

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

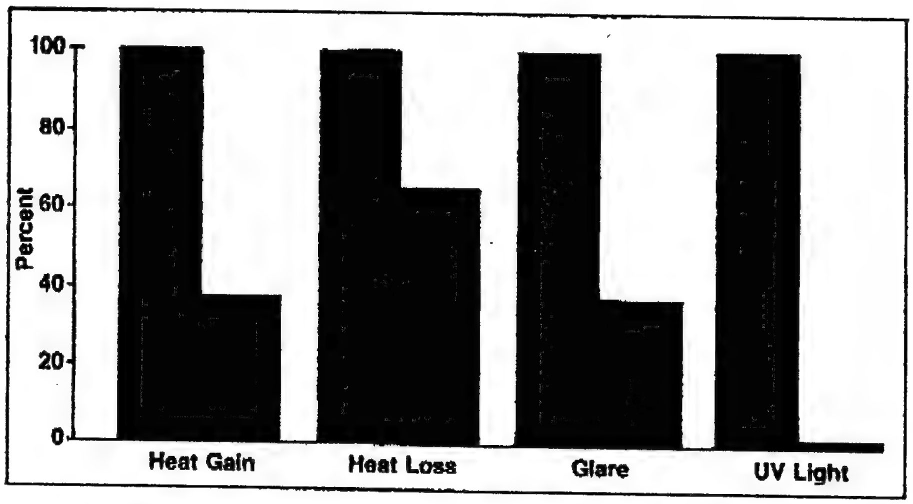
Product Performance Guide

IN30BR Bronze

IN30BR Scotchtint™ Plus All Season Window Film

Description
IN30BR **Scotchtint** Plus All Season Window Film is designed for application to the inside of existing glass windows. Its function is to reduce the solar heat gain, ultra-violet light and glare that normally would enter through the windows. The film also reduces heat loss through the windows to the outside during the cooler months. The film remains transparent while performing these functions.

Benefits
In addition to the typical benefits on ¼" (6 mm) clear glass shown at right, the film provides increased shatter resistance.



¼" (6 mm) Clear Glass   With IN30BR

Performance Data											
Glass Type		Applied Product	Shading Coefficient	Total Solar Energy Reflected	Total Solar Energy Absorbed	Total Solar Energy Transmitted	Visible Light Reflected	Visible Light Transmitted	UV Light	Emissivity	"U" Value
Single Pane	Clear	None	.94	8%	15%	77%	8%	88%	<68%	.84	1.06
Single Pane	Clear	IN30BR	[redacted]	34%	43%	23%	25%	34%	< 1%	.23	.69
Single Pane	Tinted	None	.69	5%	50%	45%	5%	50%	<29%	.84	1.06
Single Pane	Tinted	IN30BR	.31	15%	72%	13%	11%	18%	< 1%	.23	.69
Insulated Pane	Clear	None	.81	14%	26%	60%	14%	78%	<46%	.84	.50
Insulated Pane	Clear	IN30BR	[redacted]	29%	53%	18%	28%	31%	< 1%	.23	.39
Insulated Pane	Tinted	None	.55	8%	54%	38%	8%	45%	<21%	.84	.50
Insulated Pane	Tinted	IN30BR	.31	12%	77%	11%	11%	17%	< 1%	.23	.39

ECO-A6

SOLAR WINDOW SHADING

BUILDING 450

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**                                                                      **
**              T R A C E   U L T R A   A N A L Y S I S                 **
**                                                                      **
**                 by  CLARK RICHARDSON BISKUP                          **
**                                                                      **
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USDB ENERGY STUDY
LEAVENWORTH, KANSAS
USDB
RUSSELL G. BAEHR

Weather File Code:	FTLVNWTH	
Location:	LEAVENWORTH, KANSAS (USDB)	
Latitude:	39.4	(deg)
Longitude:	94.9	(deg)
Time Zone:	6	
Elevation:	770	(ft)
Barometric Pressure:	29.1	(in. Hg)
Summer Clearness Number:	0.95	
Winter Clearness Number:	0.95	
Summer Design Dry Bulb:	96	(F)
Summer Design Wet Bulb:	77	(F)
Winter Design Dry Bulb:	3	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0739	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0837	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,770.2	(Btu-min./hr/cuft/lbm)
Enthalpy Factor:	4.4333	(Btu-min./hr/cuft)

Design Simulation Period: May To October
System Simulation Period: January To December
Cooling Load Methodology: CLTD/CLF (TFM)

Time/Date Program was Run: 3:47:50 1/11/90
Dataset Name: 450A26 .TM

AIRFLOW - ALTERNATIVE 3
ECO-A6 WINDOW SCH=.36

SYSTEM SUMMARY
(Design Airflow Quantities)

System Number	System Type	Main Outside Airflow (Cfm)	Main Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Main Return Airflow (Cfm)	Main Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	MZ	870	8,764	8,764	8,764	8,764	0	670
2	FC	0	407	407	407	0	0	0
3	FC	0	147	147	147	0	0	0
Totals		870	9,318	9,318	9,318	8,764	0	670

CAPACITY - ALTERNATIVE 3
ECO-A6 WINDOW SCH=.36

SYSTEM SUMMARY
(Design Capacity Quantities)

System Number	System Type	Cooling Main Sys. Capacity (Tons)	Cooling Aux. Sys. Capacity (Tons)	Cooling Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Heating Main Sys. Capacity (Btuh)	Heating Aux. Sys. Capacity (Btuh)	Heating Preheat Capacity (Btuh)	Heating Reheat Capacity (Btuh)	Heating Humidif. Capacity (Btuh)	Heating Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	MZ	30.5	0.0	0.0	30.5	-665,959	0	0	0	0	0	-665,959
2	FC	0.0	0.0	0.0	0.0	-27,351	0	0	0	0	0	-27,351
3	FC	0.0	0.0	0.0	0.0	-9,869	0	0	0	0	0	-9,869
Totals		30.5	0.0	0.0	30.5	-703,178	0	0	0	0	0	-703,178

ENGINEERING CHECKS - ALTERNATIVE 3
ECO-A6 WINDOW SCH=.36

ENGINEERING CHECKS

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling Cfm/ Sq Ft	Cooling Cfm/ Ton	Cooling Sq Ft /Ton	Cooling Btuh/ Sq Ft	Heating Cfm/ Sq Ft	Heating Btuh/ Sq Ft	Floor Area Sq Ft
1	Main	MZ	9.93	0.91	287.4	315.2	38.07	0.91	-69.29	9,611
2	Main	FC	0.00	2.87	********	********	0.01	2.87	-192.75	142
3	Main	FC	0.00	0.54	********	********	0.00	0.54	-36.55	270

System 1 Block MZ - MULTIZONE

************************ COOLING COIL PEAK ****************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/16		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	22,575	21,512		44,087	12.05	22,293	10.21	-19,865	-19,865	0.00
Glass Solar	12,755	0		12,755	3.49	13,642	6.25	0	0	0.00
Glass Cond	7,011	0		7,011	1.92	6,947	3.18	-30,975	-30,975	5.13
Wall Cond	11,126	1,625		12,750	3.48	11,650	5.33	-30,336	-35,487	5.88
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-8,929	-8,929	1.48
Infiltration	80,527			80,527	22.01	31,225	14.29	-114,593	-114,593	18.98
Sub Total==>	133,994	23,136		157,130	42.95	85,757	39.26	-204,699	-209,850	34.76
Internal Loads										
Lights	64,850	14,646		79,496	21.73	65,153	29.83	0	0	0.00
People	33,610			33,610	9.19	17,165	7.86	0	0	0.00
Misc	45,103	0	0	45,103	12.33	45,459	20.81	0	0	0.00
Sub Total==>	143,563	14,646	0	158,209	43.24	127,778	58.50	0	0	0.00
Ceiling Load	4,888	-4,888		0	0.00	4,902	2.24	-3,119	0	0.00
Outside Air	0	0	0	43,064	11.77	0	0.00	0	-61,281	10.15
Sup. Fan Heat				10,745	2.94		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	-333,525	-333,525	55.24
Exhaust Heat		-3,282	0	-3,282	-0.90		0.00		891	-0.15
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	282,444	29,612	0	365,865	100.00	218,437	100.00	-541,343	-603,766	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	30.5	365.9	274.4	8,764	83.3	66.3	72.4	54.4	52.4	57.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	30.5	365.9								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	9,611		
Part	0		
ExFlr	225		
Roof	5,180	0	0
Wall	6,156	566	9

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-666.0	8,764	55.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	8,764	60.8	53.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-666.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	870	870
Infil	1,627	1,627
Supply	8,764	8,764
Mincfm	870	870
Return	8,505	8,764
Exhaust	8,764	870
Rm Exh	670	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	9.9
Clg Cfm/Sqft	0.91
Clg Cfm/Ton	287.45
Clg Sqft/Ton	315.24
Clg Btuh/Sqft	38.07
No. People	87
Htg % OA	9.9
Htg Cfm/SqFt	0.91
Htg Btuh/SqFt	-69.29

TEMPERATURES (F)

Type	Clg	Htg
SADB	55.0	125.0
Plenum	81.5	65.8
Return	81.5	67.2
Ret/OA	82.9	60.9
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

System 2 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/10					Mo/Hr: 7/10		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 86/ 72/ 98.0					OADB: 86		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	4,680	0		4,680	63.51	4,680	70.66	0	0	0.00
Glass Cond	671	0		671	9.10	671	10.13	-6,571	-6,571	24.02
Wall Cond	0	0		0	0.00	0	0.00	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-397	-397	1.45
Infiltration	965			965	13.10	344	5.20	-2,665	-2,665	9.75
Sub Total==>	6,316	0		6,316	85.71	5,695	85.98	-9,633	-9,633	35.22
Internal Loads										
Lights	557	371		928	12.60	557	8.41	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	557	371	0	928	12.60	557	8.41	0	0	0.00
Ceiling Load	371	-371		0	0.00	371	5.61	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				125	1.69		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	-17,718	-17,718	64.78
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	7,245	0	0	7,369	100.00	6,623	100.00	-27,351	-27,351	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	0.0	0.0	0.0	407	78.1	64.9	73.9	62.8	62.6	87.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.0	0.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	142		
Part	0		
ExFlr	10		
Roof	0	0	0
Wall	120	120	100

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-27.4	407	68.0	130.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	407	68.0	62.7
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-27.4			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	38	38
Supply	407	407
Mincfm	0	0
Return	407	407
Exhaust	38	0
Rm Exh	0	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	2.87
Clg Cfm/Ton	*******
Clg Sqft/Ton	*******
Clg Btuh/Sqft	0.01
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	2.87
Htg Btuh/SqFt	-192.75

TEMPERATURES (F)

Type	Clg	Htg
SADB	63.0	130.0
Plenum	86.3	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.2	0.0

System 3 Block FC - FAN COIL

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/16		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	246	47		293	6.16	268	7.94	-1,005	-1,466	14.86
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-793	-793	8.04
Infiltration	2,455			2,455	51.53	1,024	30.39	-3,804	-3,804	38.54
Sub Total==>	2,701	47		2,748	57.68	1,292	38.33	-5,602	-6,063	61.43
Internal Loads										
Lights	1,183	788		1,971	41.37	1,213	36.01	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	1,183	788	0	1,971	41.37	1,213	36.01	0	0	0.00
Ceiling Load	836	-836		0	0.00	865	25.66	-461	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				45	0.95		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	-3,806	-3,806	38.57
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	4,719	0	0	4,764	100.00	3,369	100.00	-9,869	-9,869	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.0	0.0	0.0	147	78.1	64.9	73.9	57.0	56.3	68.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.0	0.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	270		
Part	0		
ExFlr	20		
Roof	0	0	0
Wall	240	0	0

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-9.9	147	68.0	130.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	147	68.0	56.5
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	54	54
Supply	147	147
Mincfm	0	0
Return	147	147
Exhaust	54	0
Rm Exh	0	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.54
Clg Cfm/Ton	*******
Clg Sqft/Ton	*******
Clg Btuh/Sqft	0.00
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.54
Htg Btuh/SqFt	-36.55

TEMPERATURES (F)

Type	Clg	Htg
SADB	56.8	130.0
Plenum	87.8	62.6
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.2	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	STEAM (Therm)
Jan	9,846	51	652
Feb	8,722	51	585
March	10,321	51	606
April	9,280	51	304
May	10,268	51	0
June	13,790	80	0
July	15,630	87	0
Aug	15,336	79	0
Sept	10,517	73	0
Oct	9,829	51	0
Nov	9,297	51	530
Dec	8,884	51	726
Total	131,720	87	3,403

Building Energy Consumption = 78,804 (Btu/Sq Ft/Year) Floor Area = 10,023 (Sq Ft)
Source Energy Consumption = 179,838 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	5454	4813	5775	5133	5775	5454	5133	6096	4813	5454	5133	4813	63,847
	PK	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9
1	MISC LD													
	ELEC	2682	2366	2839	2524	2839	2682	2524	2997	2366	2682	2524	2366	31,392
	PK	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1170L		AC COND COMP <20 TONS											
	ELEC	0	0	0	0	0	3533	5510	3996	1486	0	0	0	14,525
	PK	0.0	0.0	0.0	0.0	0.0	24.9	31.3	24.8	19.2	0.0	0.0	0.0	31.3
1	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	0	428	716	491	182	0	0	0	1,817
	PK	0.0	0.0	0.0	0.0	0.0	3.2	3.7	3.1	2.5	0.0	0.0	0.0	3.7
1	EQ5313		CONTROLS											
	ELEC	0	0	0	0	0	95	102	100	79	0	0	0	377
	PK	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.3
1	EQ4002		BI CENTRIF. FAN C.V.											
	ELEC	1587	1433	1587	1536	1587	1536	1587	1587	1536	1587	1536	1587	18,686
	PK	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
1	EQ4381		PROPELLER FAN											
	ELEC	33	29	35	31	35	33	31	37	29	33	31	29	389
	PK	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	EQ4371		FAN COIL SUPPLY FAN											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

	ELEC	28	26	28	22	23	21	20	23	20	65	24	28	327
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	10	9	10	7	8	7	7	8	7	7	8	10	100
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ2101		PURCHASED DISTRICT STEAM											
	P STEAM	621	556	581	299	0	0	0	0	0	0	516	687	3,260
	PK	4.6	4.5	4.3	2.1	0.0	0.0	0.0	0.0	0.0	0.0	3.2	4.7	4.7
1	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	5	5	5	4	0	0	0	0	0	0	5	5	30
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5061		CONDENSATE RETURN PUMP											
	ELEC	11	10	11	8	0	0	0	0	0	0	10	11	60
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	CONVERTR		STEAM TO HOT WATER CONVERTER											
	P STEAM	31	28	25	5	0	0	0	0	0	0	14	39	143
	PK	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
2	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	1	1	1	0	0	0	0	0	0	0	0	1	3
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5060		CONDENSATE RETURN PUMP											
	ELEC	35	31	29	14	0	0	0	0	0	0	25	35	168
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 3
BASE LOAD

UTILITY PEAK CHECKSUMS

Utility ELECTRIC DEMAND

Peak Value 86.6 (kW)
Yearly Time of Peak 15 (hr) 7 (mo)

Hour 15 Month 7

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1170L	AC COND COMP <20 TONS	35.3	40.80
Sub Total			35.3	40.80
Sub Total			0.0	0.00
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	5.1	5.86
2		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
3		SUMMATION OF FAN ELECTRICAL DEMAND	0.0	0.05
Sub Total			5.2	6.03
Sub Total			0.0	0.00
Miscellaneous				
Lights			30.9	35.64
Base Utilities			0.0	0.00
Misc Equipment			15.2	17.52
Sub Total			46.0	53.17
Grand Total			86.6	100.00

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 3
BASE LOAD

CALIFORNIA TITLE 24 COMPLIANCE REPORT

Weather Name .... FTLVNWTH
Gross Conditioned Floor Area (sqft)...... 10,023
ACM Multiplier 1.008

ENERGY USE SUMMARY

	ELEC (kWh/yr)	DISTRICT STEAM (kBtu/yr)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	228.2	340,320.1	43.2	456,097.0	45.9
Primary Cooling					
Compressor	14,524.5	0.0	6.3	148,731.5	15.0
Tower/Cond Fans	1,817.0	0.0	0.8	18,606.2	1.9
Condenser Pump	0.0	0.0	0.0	0.0	0.0
Other Accessories	376.8	0.0	0.2	3,858.4	0.4
Auxiliary					
Supply Fans	19,501.6	0.0	8.4	199,697.0	20.1
Circulation Pumps	32.7	0.0	0.0	334.5	0.0
Base Utilities	0.0	0.0	0.0	0.0	0.0
Subtotal	19,534.3	0.0	8.4	200,031.5	20.1
Lighting	63,847.1	0.0	27.6	653,796.2	65.7
Receptacle	31,391.7	0.0	13.6	321,451.6	32.3
Domestic Hot Water	0.0	0.0	0.0	0.0	0.0
Cogeneration	0.0	0.0	0.0	0.0	0.0
Totals	131,719.6	340,320.1	100.0	1,802,572.4	181.3

ECO-A7

EXTERIOR WALL INSULATION

EXTERIOR WALL INSULATION

ENERGY CONSERVATION OPPORTUNITY: ECO-A7

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A7) analyzes the energy savings associated with reducing the amount of heat transfer through the walls of the buildings located in the USDB. Energy savings can be accomplished by adding wall insulation to the exterior walls to decrease the heat transfer coefficient (U-value) of the walls.

SCOPE:

The ECO simulation (ECO-A7) adds additional insulation to the existing exterior walls of the buildings to reduce the amount of heat transfer through outside walls. The application of this project was considered for the following buildings:

Building 472
Building 475C

If the energy savings were better and showed a feasible payback for funding, more of the buildings would have been considered. However, because of the expense of adding insulation to existing walls, this ECO was not feasible.

MODELING TECHNIQUES:

The modeling technique used to calculate the energy savings associated with the implementation of this ECO was completed using the *"Trace Ultra"* computer simulation program. The existing wall U-value is entered to calculate the amount of energy used by the building at the present time. With the additional wall insulation added, a new U-value is calculated and entered into the computer model and a new energy usage is found. The difference in energy usage from the two computer runs is the energy savings that can be obtained by implementing this ECO. The two different construction methods were considered, represented two typical buildings where a payback was most probable. The building representing the standard gypboard construction was building 472. The building representing the metal clad gypboard construction was building 475C.

ECO IMPLEMENTATION:

To implement this ECO for the buildings listed above, the existing exterior wall would have to be furred out with 2X4's or 2X2's. Insulation would be added in between the furred out studs and a gypboard would be used to cover the insulation and studs. The gypboard would be painted and trimmed out to match the existing conditions. For the exterior walls in the cell barracks of the castle, where the wall are accessible to

unsupervised inmates, a metal stud would be attached to the existing concrete walls, then insulated. A metal clad gypboard would be used to cover the metal studs from the floor to a height of 10'. The metal clad gypboard would be attached to the metal studs with a non-visible and non-removable fastener. Above the 10' border a standard gypboard would be used to save on some costs.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table A7.1 in million of BTU's per year savings as determined using the computer simulation model located in Volume 3.

The project cost is the construction cost as determined in this section plus 6% SIOH.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Costs	Simple Payback	Savings to Invest Ratio
472	229	$1,507	$61,391	54.83	0.28
475C	154	$628	$168,196	253.55	0.06

Table A7.1

This ECO project is clearly not feasible from the paybacks and savings to investment ratios seen in Table A7.1. The project costs were high relative to average structures due to the nature of the occupants of this facility. Building 475C has a higher number of payback years because the building is heated only.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 472A7
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	57916.
B. SIOH	$	3475.
C. DESIGN COST	$	3185.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	58118.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	58118.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	15.	$ 187.	11.16	2087.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	214.	$ 873.	16.15	14099.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		229.	$ 1060.		$ 16186.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 5341.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1060.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 16186.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.28
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 54.83

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475CA7
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	158675.
B. SIOH	$	9521.
C. DESIGN COST	$	8727.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	159231.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	159231.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	11.16	0.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	154.	$ 628.	16.15	10142.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		154.	$ 628.		$ 10142.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3347.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 628.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 10142.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.06
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 253.55

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A7 EXTERIOR WALL INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472							
2-1/2" METAL STUDS	10382	SQ FT	0.30	3,115	0.45	4,672	$7,787
2" ISOCYANURATE INSULATION	10382	SQ FT	1.00	10,382	0.30	3,115	$13,497
5/8" FIRECODE GYP. BD.	10382	SQ FT	0.28	2,907	0.47	4,880	$7,787
4" VINYL BASE	10382	SQ FT	0.07	727	0.08	831	$1,557
PAINT	10382	SQ FT	0.22	2,284	0.48	4,983	$7,267
6 MIL. VAPOR BARRIER	10382	SQ FT	0.03	311	0.07	727	$1,038
SUBTOTAL				$19,726		$19,207	$38,933
CONTINGENCY 10%			10%	$1,973	10%	$1,921	$3,894
SUBTOTAL				$21,699		$21,128	$42,827
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$759	13.0%	$2,747	$3,506
DIRECT COST				$22,458		$23,875	$46,333
OVERHEAD AND PROFIT			25%	$5,614	25%	$5,969	$11,583
SUBTOTAL				$28,072		$29,844	$57,916
CONSTRUCTION COST							$57,916

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

ECO-A7 EXTERIOR WALL INSULATION	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475C							
METAL CLAD GYP. BD. AND TRACK	10529	SQ FT	4.60	48,433	1.00	10,529	$58,962
2-1/2" THERMAL INSULATION	10529	SQ FT	0.25	2,632	0.10	1,053	$3,685
6 MIL. VAPOR BARRIER	10529	SQ FT	0.03	316	0.07	737	$1,053
CAULK	10529	SQ FT	0.06	632	0.14	1,474	$2,106
MOBILIZATION	10529	SQ FT			0.30	3,159	$3,159
2-1/2" METAL STUDS	11359	SQ FT	0.30	3,408	0.60	6,815	$10,223
2-1/2" BATT INSULATION	11359	SQ FT	0.25	2,840	0.10	1,136	$3,976
5/8" FIRECODE GYP. BD.	11359	SQ FT	0.28	3,181	0.57	6,475	$9,655
CAULK	11359	SQ FT	0.06	682	0.14	1,590	$2,272
PAINT	11359	SQ FT	0.22	2,499	0.48	5,452	$7,951
6 MIL. VAPOR BARRIER	11359	SQ FT	0.03	341	0.07	795	$1,136
MOBILIZATION	11359	SQ FT			0.30	3,408	$3,408
SUBTOTAL				$64,963		$42,623	$107,586
CONTINGENCY 10%			10%	$6,496	10%	$4,262	$10,758
SUBTOTAL				$71,459		$46,885	$118,344
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$2,501	13.0%	$6,095	$8,596
DIRECT COST				$73,960		$52,980	$126,940
OVERHEAD AND PROFIT			25%	$18,490	25%	$13,245	$31,735
SUBTOTAL				$92,450		$66,225	$158,675
CONSTRUCTION COST							$158,675

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PREVIOUS EDITION MAY BE USED

A9

ARCHITECTURAL REPAIRS

ARCHITECTURAL REPAIRS - A9

PURPOSE:

The architectural repair section (A9) studied any repairs that might improve the energy efficiency of the buildings architecturally. Although these projects are small in nature, their completion may help the buildings save energy. The energy savings associated with these opportunities are difficult to calculate, therefore this section serves as recommended repairs.

SCOPE:

The architectural repairs encompassed many of the buildings and are as follows:

Building 463	Building 473
Building 464	Building 475
Building 465	Building 475A
Building 466	Building 475E
Building 472	

Repairs are located in different areas of each of the buildings.

SUMMARY:

To summarize, a listing of the various architectural repairs is listed and description of the repair. Following the list are cost estimates for each of the repairs.

1. In building 450 a condensate line is presently routed through the door on the first floor. The door is (108) as shown on the building plan in the field data for the building in Volume 4. The pipe needs to be re-routed through the masonry wall adjacent to the door. A hole will need to be drilled through the masonry and the piping installed through the wall. The estimated cost to complete this repair is $424.

2. In building 464 a light fixture is located directly in the way of the attic access for the building. The light fixture can be relocated to the side of the access hole to the attic. This project needs to be completed before the attic insulation project could be implemented. The estimated cost to relocate the light is $73.

3. The vestibule doors for the entrance of building 465 need to be relocated. One of the doors is located on the ground floor and needs to be moved back. The side light also needs to be moved back in conjunction with the door. The swing of the door needs to be reversed to the present swing to ensure correct people

movement. The other door that needs to be relocated is for the entrance to the first floor. To relocate the vestibule doors, the estimated cost is $1,671.

4. On the third floor of building 466, the metal ceiling panels need to be repaired. The metal panels for the area need to be demolished and metal panels are available from another area to replace the ones removed. The estimated cost to repair the ceiling is $582.

5. Building 472 needs to have an attic access in a classroom on the third floor and have door (106) on the first floor adjusted and a new lock installed. The location of the door can be seen in the field notes located under the building in Volume 4. The estimated cost for these items is $1,219.

6. A door in building 473 needs to replaced with a new metal hollow core door. The door to be replaced is (106) as seen on the first floor plan located in the field notes, Volume 4. The replacement of this door has an estimated cost of $2,132.

7. Several doors located in the rotunda (building 475) need to be replaced. The doors are seen on the building floor plans located in the field notes, Volume 4. The doors are (30A, 30C, 30E, and 30H). The estimated cost to replace these doors is $13,727.

8. Adjacent to window (201) the masonry needs to be repaired in building 475A and the vestibule door (30B) needs to be moved back to ensure a proper flow of people. The locations of the above numbered window and door can be seen in the field notes for this building, Volume 4. The estimated cost for this work is $1,221.

9. Building 475E has several plywood covered accesses that need to be replaced with a standard door. The plywood needs to be removed and a framed door installed. The estimated cost to repair the 15 places is $50,302.

All of the above stated items have included in the estimated cost finishing of any walls, doors and frames with filling and painting to match the existing surrounding walls and doors.

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463							
DEMOLITION	1	EA			20.00	20	$20
DRILL 3/4" HOLE	5	HR	5.00	25	20.00	100	$125
CHECK SWING VALVE	1	EA	10.90	11	9.90	10	$21
3/4" COPPER PIPE	18	FT	1.90	34	3.00	54	$88
SEALANT	5	FT	0.60	3	1.40	7	$10
MOBILIZATION	1	EA			15.00	15	$15
SUBTOTAL				$73		$206	$279
CONTINGENCY 10%			10%	$7	10%	$21	$28
SUBTOTAL				$80		$227	$307
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$3	13.0%	$29	$32
DIRECT COST				$83		$256	$339
OVERHEAD AND PROFIT			25%	$21	25%	$64	$85
SUBTOTAL				$104		$320	$424
CONSTRUCTION COST							$424

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 464							
MOVE LIGHT FIXTURE	1	EA			31.00	31	$31
MOBILIZATION	1	EA			15.00	15	$15
SUBTOTAL						$46	$46
CONTINGENCY 10%			10%		10%	$5	$5
SUBTOTAL						$51	$51
WORK COMP,TAX,SOC.SEC.,INS			3.50%		13.0%	$7	$7
DIRECT COST						$58	$58
OVERHEAD AND PROFIT			25%		25%	$15	$15
SUBTOTAL						$73	$73
CONSTRUCTION COST							$73

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CONSTRUCTION COST ESTIMATE			DATE PREPARED 4/2/90				SHEET 3 OF 9
PROJECT: USDB ENERGY STUDY			BASIS FOR ESTIMATE				
LOCATION: FORT LEAVENWORTH, KS			X CODE A (NO DESIGN COMPLETED)				
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP			CODE B (PRELIMINARY DESIGN) / CODE C (FINAL DESIGN) / OTHER (SPECIFY)				
DRAWING NO.: NONE			ESTIMATOR: DLS			CHECKED BY: TOL	

A9 ARCHITECTURAL REPAIRS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 465							
MOVE VESTIBULE DOOR AND SIDE LIGHTS BACK							
DEMOLITION	1	EA			150.00	150	$150
INSTALLATION	1	EA			200.00	200	$200
WEATHERSTRIP DOOR	17	FT	1.40	24	2.60	44	$68
INSTALL THRESHOLD	1	EA	40.00	40	10.00	10	$50
MOBILIZATION	1	EA			50.00	50	$50
MOVE VESTIBULE DOOR (07) AND SIDE LIGHTS BACK							
DEMOLITION	1	EA			150.00	150	$150
INSTALLATION	1	EA			200.00	200	$200
WEATHERSTRIP DOOR	17	FT	1.40	24	2.60	44	$68
INSTALL THRESHOLD	1	EA	40.00	40	10.00	10	$50
REVERSE DOOR SWING	1	EA			50.00	50	$50
MOBILIZATION	1	EA			50.00	50	$50
SUBTOTAL				$128		$958	$1,086
CONTINGENCY 10%			10%	$13	10%	$96	$109
SUBTOTAL				$141		$1,054	$1,195
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$5	13.0%	$137	$142
DIRECT COST				$146		$1,191	$1,337
OVERHEAD AND PROFIT			25%	$36	25%	$298	$334
SUBTOTAL				$182		$1,489	$1,671
CONSTRUCTION COST							$1,671

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 466							
REPAIR DAMAGED METAL CEILING PANELS							
DEMOLITION	75	SQ FT			1.00	75	$75
INSTALL METAL PANELS TAKEN FROM OTHER LOCATIONS	75	SQ FT			2.00	150	$150
PAINT	200	SQ FT	0.10	20	0.40	80	$100
MOBILIZATION	1	EA			50.00	50	$50
SUBTOTAL				$20		$355	$375
CONTINGENCY 10%			10%	$2	10%	$36	$38
SUBTOTAL				$22		$391	$413
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$1	13.0%	$51	$52
DIRECT COST				$23		$442	$465
OVERHEAD AND PROFIT			25%	$6	25%	$111	$117
SUBTOTAL				$29		$553	$582
CONSTRUCTION COST							$582

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 9
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472							
INSTALL ACCESS HOLE							
DEMOLITION	1	EA			125.00	125	$125
ACCESS FRAME AND COVER	1	EA	419.00	419	23.00	23	$442
PAINT	1	EA	5.00	5	15.00	15	$20
MOBILIZATION	1	EA			75.00	75	$75
REPAIRS TO DOOR (106)							
REPLACE LOCK	1	EA	102.00	102	20.00	20	$122
ADJUST DOOR	1	EA			20.00	20	$20
MOBILIZATION	1	EA			25.00	25	$25
SUBTOTAL				$526		$303	$829
CONTINGENCY 10%			10%	$53	10%	$30	$83
SUBTOTAL				$579		$333	$912
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$20	13.0%	$43	$63
DIRECT COST				$599		$376	$975
OVERHEAD AND PROFIT			25%	$150	25%	$94	$244
SUBTOTAL				$749		$470	$1,219
CONSTRUCTION COST							$1,219

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 6 OF 9
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 473							
INSTALL NEW HALLOW METAL DOOR IN (106)							
REMOVE DOOR/FRAME	1	EA			100.00	100	$100
NEW DOOR/FRAME	1	EA	420.00	420	80.00	80	$500
FINISH HARDWARE	1	EA	510.00	510	90.00	90	$600
PAINT	1	EA	5.00	5	35.00	35	$40
SEALANT/CAULK	36	FT	0.60	22	1.40	50	$72
MOBILIZATION	1	EA			140.00	140	$140
SUBTOTAL				$957		$495	$1,452
CONTINGENCY 10%			10%	$96	10%	$50	$146
SUBTOTAL				$1,053		$545	$1,598
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$37	13.0%	$71	$108
DIRECT COST				$1,090		$616	$1,706
OVERHEAD AND PROFIT			25%	$272	25%	$154	$426
SUBTOTAL				$1,362		$770	$2,132
CONSTRUCTION COST							$2,132

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 7 OF 9

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	

DRAWING NO. NONE	ESTIMATOR DLS	CHECKED BY TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475							
INSTALL NEW HALLOW METAL DOORS IN (30A, 300, 30E, AND 30H)							
REMOVE DOOR/FRAME	4	EA			200.00	800	$800
NEW DOOR/FRAME	4	EA	840.00	3,360	160.00	640	$4,000
FINISH DOOR	4	EA	680.00	2,720	120.00	480	$3,200
PAINT	4	EA	20.00	80	80.00	320	$400
SEALANT/CAULK	160	FT	0.60	96	1.40	224	$320
MOBILIZATION	4	EA			160.00	640	$640
SUBTOTAL				$6,256		$3,104	$9,360
CONTINGENCY 10%			10%	$626	10%	$310	$936
SUBTOTAL				$6,882		$3,414	$10,296
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$241	13.0%	$444	$685
DIRECT COST				$7,123		$3,858	$10,981
OVERHEAD AND PROFIT			25%	$1,781	25%	$965	$2,746
SUBTOTAL				$8,904		$4,823	$13,727
CONSTRUCTION COST							$13,727

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 8 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: DLS	CHECKED BY: TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475A							
REPAIR MASONRY WALL AT WINDOW (201)							
REMOVE BRICK	20	SQ FT			1.50	30	$30
TOOTH-IN NEW BRICK	30	SQ FT	2.09	63	3.67	110	$173
MOBILIZATION	1	EA			75.00	75	$75
MOVE VESTIBULE DOOR (30B) AND SIDE LIGHTS BACK							
DEMOLITION	1	EA			150.00	150	$150
INSTALLATION	1	EA			200.00	200	$200
WEATHERSTRIP DOOR	17	FT	1.40	24	2.60	44	$68
INSTALL THRESHOLD	1	EA	40.00	40	10.00	10	$50
MOBILIZATION	1	EA			50.00	50	$50
SUBTOTAL				$127		$669	$796
CONTINGENCY 10%			10%	$13	10%	$67	$80
SUBTOTAL				$140		$736	$876
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$5	13.0%	$96	$101
DIRECT COST				$145		$832	$977
OVERHEAD AND PROFIT			25%	$36	25%	$208	$244
SUBTOTAL				$181		$1,040	$1,221
CONSTRUCTION COST							$1,221

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 9 OF 9

PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)
	CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE C (FINAL DESIGN)
	OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
NONE	DLS	TOL

A9 ARCHITECTURAL REPAIRS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475E							
REPLACE PLYWOOD WITH WORKING DOORS							
REMOVE DOOR/FRAME	15	EA			150.00	2,250	$2,250
NEW DOOR/FRAME	15	EA	840.00	12,600	160.00	2,400	$15,000
FINISH HARDWARE	15	EA	680.00	10,200	120.00	1,800	$12,000
PAINT	15	EA	20.00	300	80.00	1,200	$1,500
8" LIGHTWEIGHT C.M.U.	40	SQ FT	1.60	64	2.20	88	$152
SEALANT/CAULK	600	FT	0.60	360	1.40	840	$1,200
MOBILIZATION	15	EA			150.00	2,250	$2,250
SUBTOTAL				$23,524		$10,828	$34,352
CONTINGENCY 10%			10%	$2,352	10%	$1,083	$3,435
SUBTOTAL				$25,876		$11,911	$37,787
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$906	13.0%	$1,548	$2,454
DIRECT COST				$26,782		$13,459	$40,241
OVERHEAD AND PROFIT			25%	$6,696	25%	$3,365	$10,061
SUBTOTAL				$33,478		$16,824	$50,302
CONSTRUCTION COST							$50,302

ENG. FORM 150
1AVC-59

ECO-M1

SCHEDULE AIR HANDLING EQUIPMENT

SCHEDULE AIR HANDLING EQUIPMENT

ENERGY CONSERVATION OPPORTUNITY: ECO-M1

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M1) analyzes the energy savings associated with controlling HVAC systems using Night Setback. Energy saving can be accomplished by turning down AHU's during times when spaces are unoccupied.

SCOPE:

The ECO simulation (ECO-M1) includes expanding the existing EMS system located at the USDB. Three AHU's in building 465 and eleven units located in building 464 can be added to the EMS network. This will allow these AHU's to be set back when they are not needed. Buildings 450, 463, and 473 are already controlled by the EMS system and take advantage of Night Setback. The Chilled Water and Heating Hot Water Pumps that serve buildings 463, 472 and parts of 464 and 473 are not on the EMS system and continue to run at night even though the air handlers are turned off. These pumps will show an energy savings when added to the EMS system. Buildings such as the Castle, 466, and floors 2 and 3 of 465 are domiciles and require space conditioning 24 hours a day. The air handler in the print room in building 472 is used for dehumidification and must run continuously. Therefore buildings 466, 472 and 475 A-H are not included as part of this ECO.

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy saving associated with implementation of this ECO were completed using the Trace Ultra computer simulation models developed as a base load on the facility. The existing HVAC systems were scheduled to run constantly throughout the heating and cooling seasons. Then an alternative run was done scheduling the air handlers to be shut off or turned down at times when heating or cooling were not required. The difference in the energy usage for these two computer runs is the energy saving from ECO-M1. Hand calculation were done to calculate the energy saving obtained when adding the pumps in buildings The cost of implementing this ECO was calculated using an electronic spreadsheet .

ECO IMPLEMENTATION:

The Air Handling Unit in building 464 and 465 have the capability of connecting to the existing EMS system located on the USDB. These unit will require new relays located at the units and control wiring to connect them to the EMS system. The Chilled Water and Heating Hot Water pumps serving buildings 463, 472 and parts of 464 and 473 can be connected to the existing relays which control the air handlers already in these buildings.

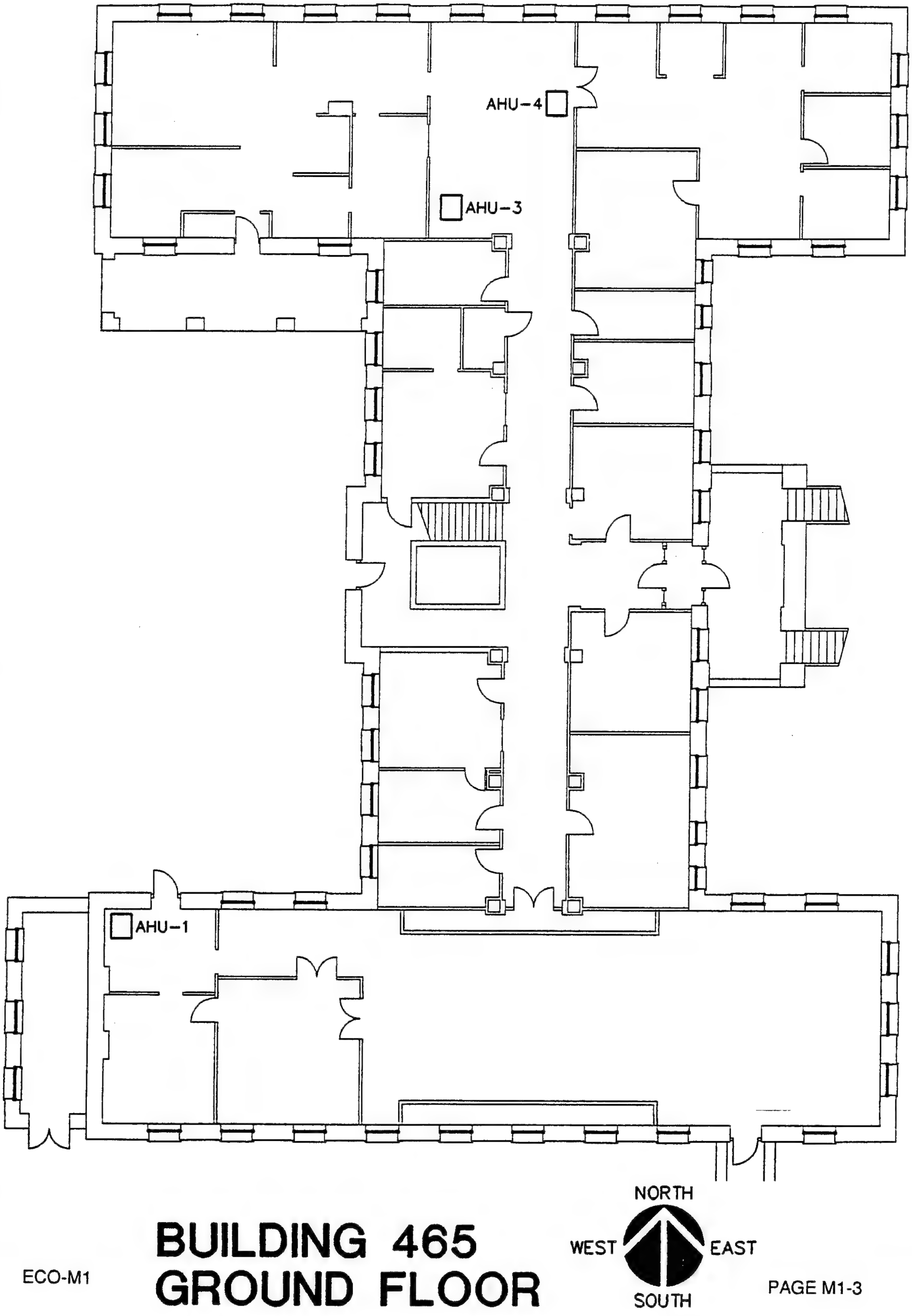
SUMMARY:

The project cost to implement this ECO shown Table M1-1are construction costs +6% SIOH.

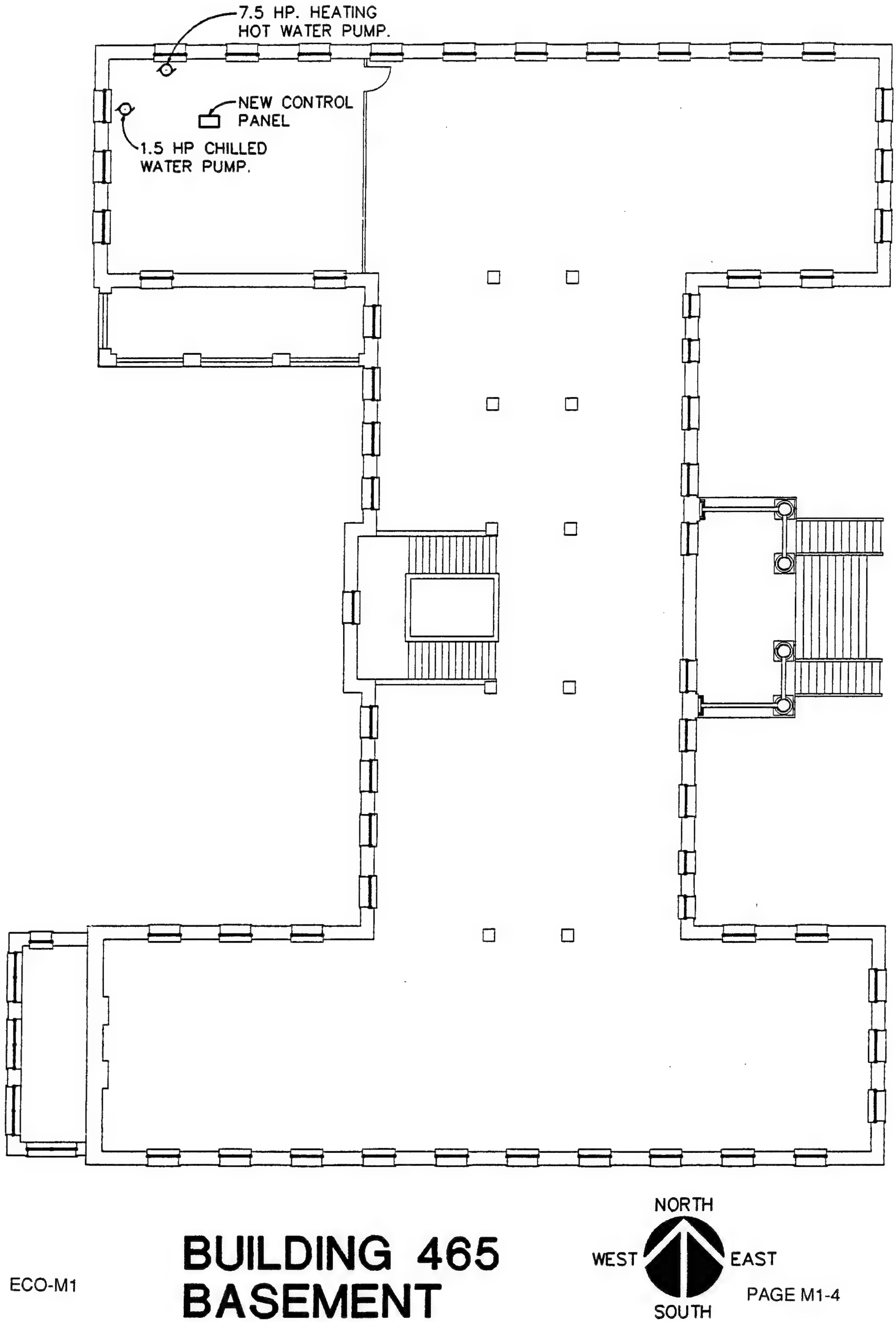
The energy savings associated with the implementation of this ECO by building is shown below in Table M1-1. A dollars per year savings as determined using the computer simulation model along with hand calculation for pump energy savings.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
463	10	$127	$491	3.76	2.31
464	45	$396	$9,255	21.85	.42
465	280	$891	$9,972	10.57	1.03
472	20	$248	$5,932	22.5	.39

Table M1-1

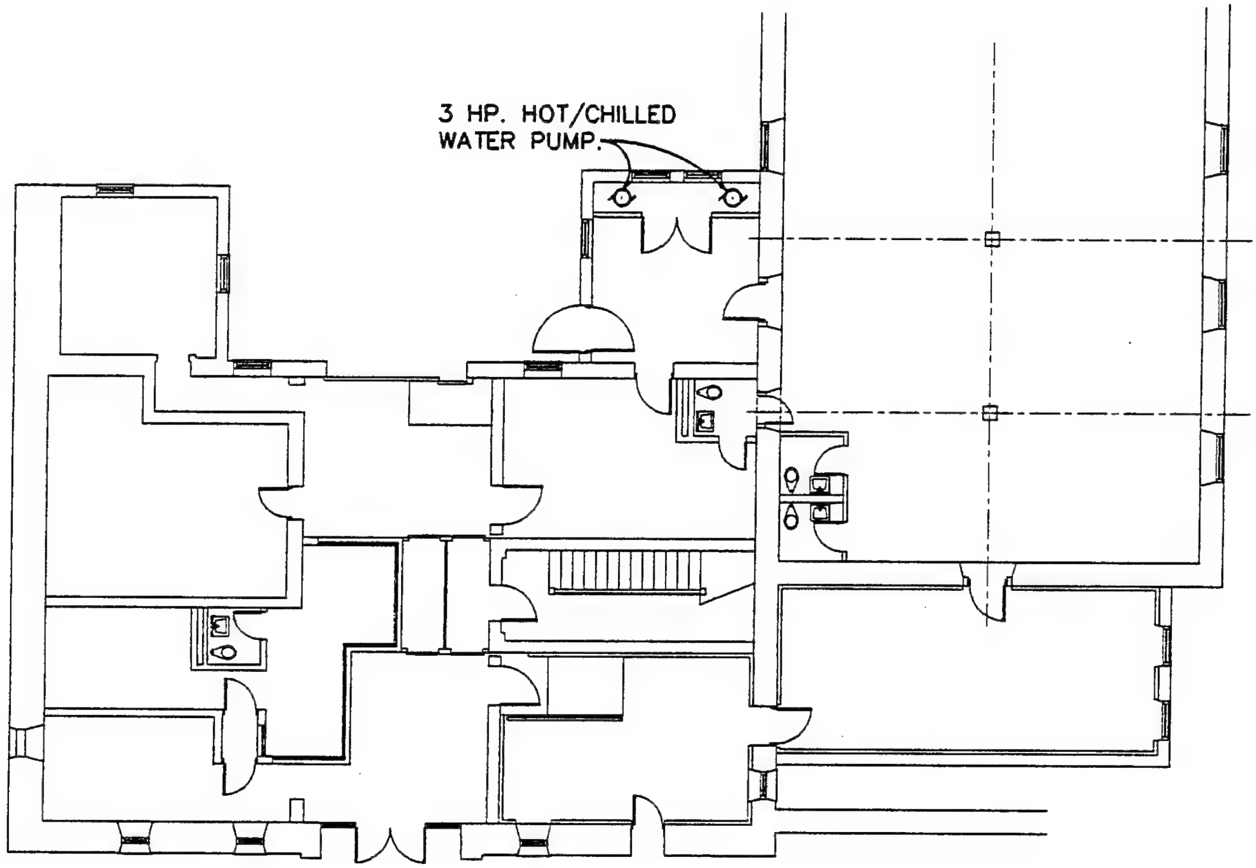


BUILDING 465
GROUND FLOOR

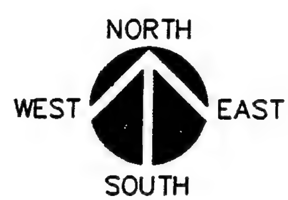


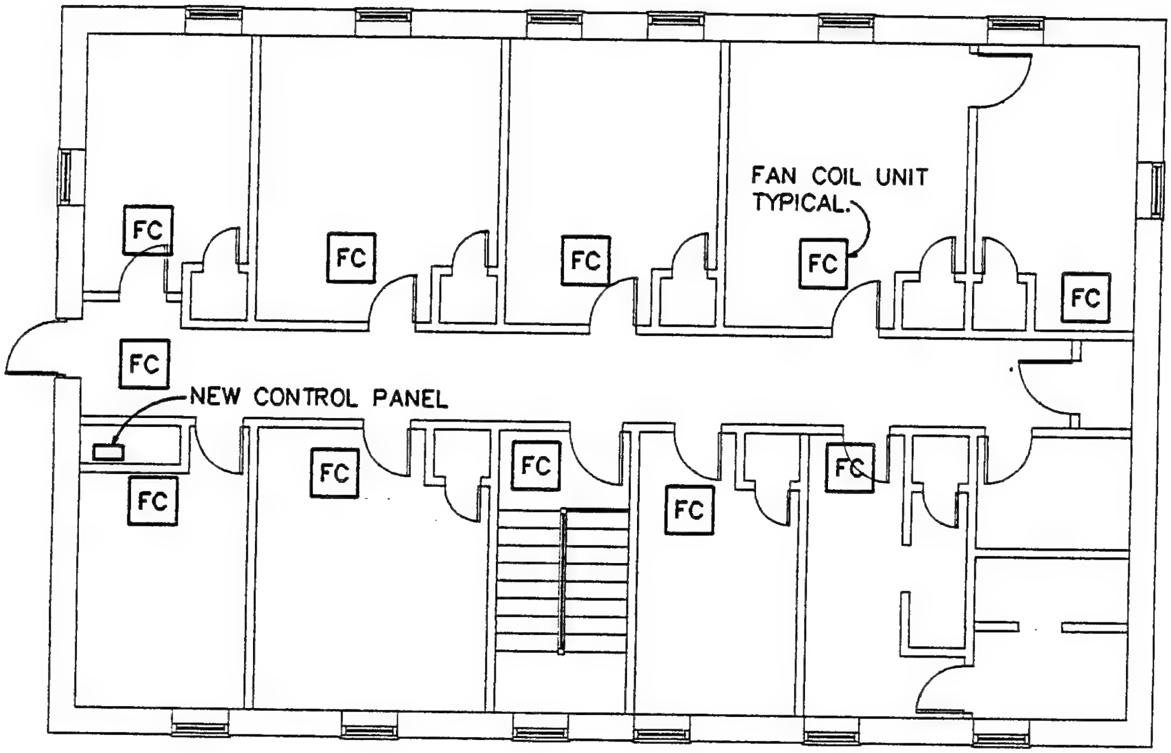
BUILDING 465 BASEMENT

ECO-M1

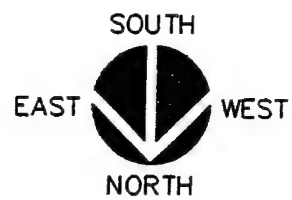


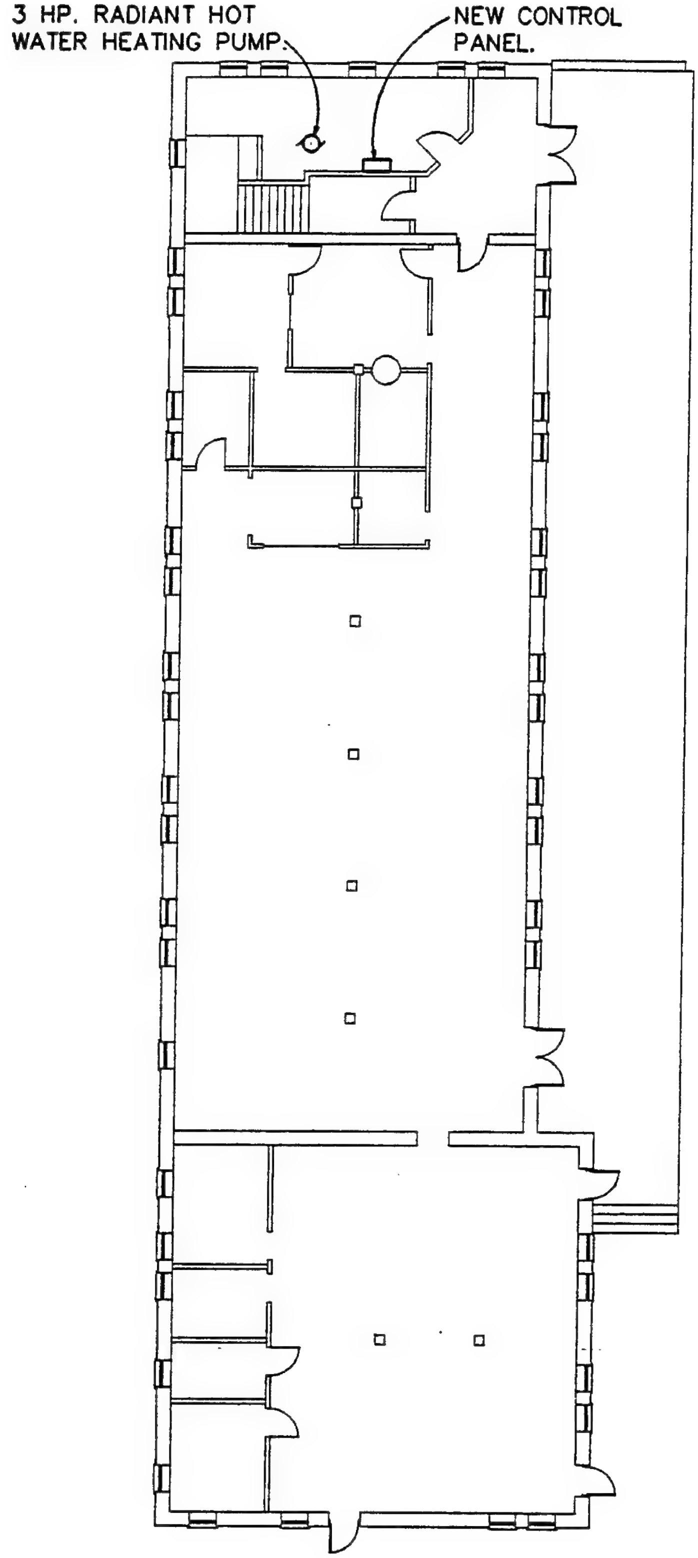
BUILDING 463
FIRST FLOOR



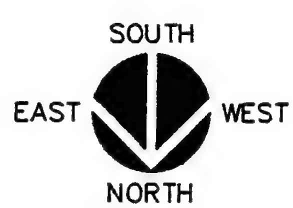


BUILDING 464
THIRD FLOOR





BUILDING 472
FIRST FLOOR



LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM1463
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	464.
B. SIOH	$	28.
C. DESIGN COST	$	26.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	466.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	466.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	10.	$ 124.	8.69	1078.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		10.	$ 124.		$ 1078.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 356.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 124.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1078.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.31
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 3.76

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM1464
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	8731.
B. SIOH	$	524.
C. DESIGN COST	$	480.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	8762.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	8762.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	26.	$ 323.	8.69	2807.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	19.	$ 78.	11.67	910.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		45.	$ 401.		$ 3717.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 1227.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 401.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 3717.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.42
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 21.85

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM1465
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	9408.
B. SIOH	$	564.
C. DESIGN COST	$	517.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	9440.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	9440.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	19.	$ 236.	8.69	2051.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	161.	$ 657.	11.67	7667.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		180.	$ 893.		$ 9718.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3207.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 893.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 9718.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.03
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 10.57

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM1472
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	5596.
B. SIOH	$	336.
C. DESIGN COST	$	308.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	5616.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	5616.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	20.	$ 249.	8.69	2164.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		20.	$ 249.		$ 2164.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 714.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS => 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 249.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2164.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.39
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 22.55

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 1 OF 4
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M1	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463 FIRST FLOOR START/STOP THE HOT/CHILLED							
WATER PUMP WIRE FROM EXISTING CONTROL PANEL							
18 GA. TWISTED PAIR WIRE	85	FT	0.10	$9	0.31	$26	$35
1/2" CONDUIT	85	FT	0.77	$65	1.95	$166	$231
EQUIPMENT MOUNTED CONTROL RELAY	1	EA	18.00	$18	22.00	$22	$40
SUBTOTAL				$92		$214	$306
CONTINGENCY 10%			10%	$9	10%	$21	$30
SUBTOTAL				$101		$235	$336
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$4	13.0%	$31	$35
DIRECT COST				$105		$266	$371
OVERHEAD AND PROFIT			25%	$26	25%	$67	$93
SUBTOTAL				$131		$333	$464
CONSTRUCTION COST							$464

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 4
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR MJM	CHECKED BY MAW

ECO-M1	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 464 THIRD FLOOR START/STOP THE FAN COIL UNITS							
EXTEND TRUNK TO NEW CONTROL PANEL							
CONTROL PANEL (JOHNSON FPU)	1	EA	3280.00	$3,280	450.00	$450	$3,730
18 GA. TWISTED PAIR WIRE	570	FT	0.10	$57	0.31	$177	$234
1/2" CONDUIT	570	FT	0.77	$439	1.95	$1,112	$1,550
EQUIPMENT MOUNTED CONTROL RELAY	11	EA	18.00	$198	22.00	$242	$440
SUBTOTAL				$3,974		$1,980	$5,954
CONTINGENCY 10%			10%	$397	10%	$198	$595
SUBTOTAL				$4,371		$2,178	$6,549
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$153	13.0%	$283	$436
DIRECT COST				$4,524		$2,461	$6,985
OVERHEAD AND PROFIT			25%	$1,131	25%	$615	$1,746
SUBTOTAL				$5,655		$3,076	$8,731
CONSTRUCTION COST							$8,731

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CONSTRUCTION COST ESTIMATE		DATE PREPARED 4/2/90		SHEET 3 OF 4
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE		
LOCATION FORT LEAVENWORTH, KS		X CODE A (NO DESIGN COMPLETED)		
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)		
DRAWING NO. NONE	ESTIMATOR MJM		CHECKED BY MAW	

ECO-M1	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 465 START/STOP THE FAN COIL UNITS							
START/STOP HOT/CHILLED WATER PUMP EXTEND TRUNK TO NEW CONTROL PANEL							
CONTROL PANEL (JOHNSON FPU)	1	EA	2380.00	$2,380	450.00	$450	$2,830
18 GA. TWISTED PAIR WIRE	1070	FT	0.10	$107	0.31	$332	$439
1/2" CONDUIT	1070	FT	0.77	$824	1.95	$2,087	$2,910
EQUIPMENT MOUNTED RELAY	4	EA	18.00	$72	22.00	$88	$160
SUBTOTAL				$3,383		$2,956	$6,339
CONTINGENCY 10%			10%	$338	10%	$296	$634
SUBTOTAL				$3,721		$3,252	$6,973
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$130	13.0%	$423	$553
DIRECT COST				$3,851		$3,675	$7,526
OVERHEAD AND PROFIT			25%	$963	25%	$919	$1,882
SUBTOTAL				$4,814		$4,594	$9,408
CONSTRUCTION COST							$9,408

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 4
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M1	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472 BASEMENT START/STOP THE HOT WATER							
RADIANT HEAT PUMP EXTEND TRUNK TO NEW CONTROL PANEL							
CONTROL PANEL (JOHNSON FPU)	1	EA	1930.00	$1,930	450.00	$450	$2,380
18 GA. TWISTED PAIR WIRE	440	FT	0.10	$44	0.31	$136	$180
1/2" CONDUIT	440	FT	0.77	$339	1.95	$858	$1,197
EQUIPMENT MOUNTED CONTROL RELAY	1	EA	18.00	$18	22.00	$22	$40
SUBTOTAL				$2,331		$1,466	$3,797
CONTINGENCY 10%			10%	$233	10%	$147	$380
SUBTOTAL				$2,564		$1,613	$4,177
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$90	13.0%	$210	$300
DIRECT COST				$2,654		$1,823	$4,477
OVERHEAD AND PROFIT			25%	$663	25%	$456	$1,119
SUBTOTAL				$3,317		$2,279	$5,596
CONSTRUCTION COST							$5,596

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ECO-M1

SCHEDULE AIR HANDLING EQUIPMENT

BUILDING 463

ECO-M1 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION BASE ENERGY (THERMS)	STEAM CONSUMPTION ECO-M1 LOAD (THERMS)	STEAM CONSUMPTION ENERGY SAVINGS (MBTU)	ELECTRIC CONSUMPTION BASE LOAD (KW)	ELECTRIC CONSUMPTION ECO-M1 LOAD (KW)	ELECTRIC CONSUMPTION ENERGY SAVINGS (MBTU)	TOTAL SAVINGS ($)
463	1,577	1,577	0	83,903	82,711	4	$51
464	2,195	2,006	19	91,802	84,278	26	$396
465	35,995	34,388	161	231,123	225,586	19	$891
							$1,338

CALCULATION SHEET	DATE Oct-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-M1	COMPUTED BY RGB	CHECKED BY MAW

HAND CALCULATION OF ENERGY SAVINGS ASSOCIATED WITH
NIGHT SHUT DOWN OF CHILLED WATER PUMPS

BUILDING 463

3 HP. MOTOR
1 HP = 74,600 WATTS PER HOUR
ESTIMATED PUMP SAVINGS % BASED ON COMPUTER
SIMULATIONS OF BUILDINGS 465 AND 464

ENERGY = HP X 74,600 WATTS/HR X 12 HR

BUILDING NUMBER	PUMP TYPE	ENERGY KW / YR	SAVINGS %	SAVINGS KW / YR	SAVINGS MBTU / YR	SAVINGS $ / YR
463	CHILLER	3612	0.33	1192	4.07	$51

ECO-M2

DRY-BULB ECONOMIZER CONTROLS

DRY-BULB ECONOMIZER CONTROLS

ENERGY CONSERVATION OPPORTUNITY: ECO-M2

(High Humidity lower temp)

PURPOSE:

This Energy Conservation Opportunity (ECO-M2) analyzes the energy savings associated with repairing and maintaining existing dry bulb economizer systems. Energy savings can be accomplished by turning off or cycling refrigeration systems and using outside air as a cooling source when outdoor temperatures are at or below 68° F. This outdoor air is then mixed with room air and cooled, if necessary, to obtain the design supply air temperature. These systems monitor and respond to dry bulb temperatures only. The implementation of this project will not include the addition of any new economizer units because all building systems compatible with air side economizers currently have that equipment installed.

SCOPE:

The ECO simulation (ECO-M2) includes the reconnecting of the economizer linkage and the replacement of controls for the existing dry bulb economizers. The application of this project was considered for 6 air handling units: building 463 (second and third floors), building 464 (first and second floors) and building 473 (second and third floors). Building 450 was not considered because it already has an operable dry bulb economizer system. The rest of the buildings have operable windows and their HVAC systems are not compatible with dry bulb economizers.

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy savings associated with implementation of this ECO were completed using the "Trace" computer simulation. The existing HVAC system was set up without a dry bulb economizer. The computer model was then run with the economizer activated at or below 68° F, during the cooling season only, and a new energy usage was found. The difference in energy usage from the two computer runs is the energy savings that can be obtained by implementing ECO-M2.

ECO IMPLEMENTATION:

The Air Handling Units in buildings 463, 464 and 473 have existing dry bulb economizer capabilities. The controls to these systems are inoperable and the linkages have been disconnected. In order to implement this ECO, the old controls must be removed and replaced and linkages must be reconnected. Also, the return and outside air dampers on the air handling unit in building 463, third floor, need to be replaced.

A means of air relief may also need to be provided. Possible choices are partially open windows, exhaust dampers or exhaust fans. For this ECO simulation, it is assumed that the excess air can escape the buildings.

SUMMARY:

The project cost, energy savings, simple payback, and savings to investment ratio (S.I.R.) for implementation of this ECO by building is shown in Table M2-1. This project cost is the construction cost as determined on the Cost Estimate Form plus 6% SIOH.

Building Number	Electric Energy Savings (MBTU/yr.)	Cost Savings	Project Cost	Simple Payback	S.I.R.
463	2.155	$27	$1,547	57.3	0.15
464	15.46	$193	$1,413	7.3	1.20
473	5.609	$70	$1,413	20.2	0.45

Table M2-1

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM2463
ANALYSIS DATE: 03-31-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1459.
B. SIOH	$	88.
C. DESIGN COST	$	80.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1464.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1464.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	2.155	$ 27.	8.69	235.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		2.	$ 27.		$ 235.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 78.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 27.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 235.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.16
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 54.22

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM2464
ANALYSIS DATE: 03-31-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1333.
B. SIOH	$	80.
C. DESIGN COST	$	73.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1337.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1337.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	15.46	$ 192.	8.69	1668.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	-1.114	$ -5.	11.67	-58.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		14.	$ 187.		$ 1610.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 531.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 187.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1610.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.20
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 7.15

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM2473
ANALYSIS DATE: 03-31-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1333.
B. SIOH	$	80.
C. DESIGN COST	$	73.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1337.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1337.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	5.609	$ 70.	8.69	608.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		6.	$ 70.		$ 608.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 201.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 70.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 608.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.45
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 19.10

CONSTRUCTION COST ESTIMATE			DATE PREPARED 4/2/90				SHEET 1 OF 3
PROJECT: USDB ENERGY STUDY			BASIS FOR ESTIMATE				
LOCATION: FORT LEAVENWORTH, KS			X CODE A (NO DESIGN COMPLETED)				
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP			CODE B (PRELIMINARY DESIGN)				
			CODE C (FINAL DESIGN)				
			OTHER (SPECIFY)				
DRAWING NO.: NONE		ESTIMATOR: MJM			CHECKED BY: MAW		

ECO-M2 DRY-BULB ECONOMIZER CONTROLS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 463 ECONOMIZER CONTROLS FOR AHU LOCATED							
ON SECOND FLOOR NORTHEAST ENTRY							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
BUILDING 463 ECONOMIZER CONTROLS FOR AHU LOCATED							
ON THIRD FLOOR ABOVE STAIRS							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
18 X 28 RETURN AIR DAMPER	1	EA	24.00	$24	19.25	$19	$43
18 X 28 OUTSIDE AIR DAMPER	1	EA	24.00	$24	19.25	$19	$43
SUBTOTAL				$792		$214	$1,006
CONTINGENCY 10%			10%	$79	10%	$21	$100
SUBTOTAL				$871		$235	$1,106
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$30	13.0%	$31	$61
DIRECT COST				$901		$266	$1,167
OVERHEAD AND PROFIT			25%	$225	25%	$67	$292
SUBTOTAL				$1,126		$333	$1,459
CONSTRUCTION COST							**$1,459**

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE			DATE PREPARED 4/2/90			SHEET 2 OF 3
PROJECT USDB ENERGY STUDY			BASIS FOR ESTIMATE			
LOCATION FORT LEAVENWORTH, KS			X CODE A (NO DESIGN COMPLETED)			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			CODE B (PRELIMINARY DESIGN)			
			CODE C (FINAL DESIGN)			
DRAWING NO. NONE	ESTIMATOR MJM		OTHER (SPECIFY)		CHECKED BY MAW	

ECO-M2 DRY-BULB ECONOMIZER CONTROLS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 464 ECONOMIZER CONTROLS FOR AHU LOCATED ON FIRST FLOOR IN BARBERSHOP							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
BUILDING 464 ECONOMIZER CONTROLS FOR AHU LOCATED ON SECOND FLOOR IN BREAKROOM							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
SUBTOTAL				$744		$176	$920
CONTINGENCY 10%			10%	$74	10%	$18	$92
SUBTOTAL				$818		$194	$1,012
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$29	13.0%	$25	$54
DIRECT COST				$847		$219	$1,066
OVERHEAD AND PROFIT			25%	$212	25%	$55	$267
SUBTOTAL				$1,059		$274	$1,333
CONSTRUCTION COST							$1,333

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 3 OF 3
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M2 **DRY-BULB ECONOMIZER CONTROLS**	QUANTITY NO. UNITS	UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 473 ECONOMIZER CONTROLS FOR AHU LOCATED							
ON SECOND FLOOR HALLWAY SOUTH END							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
BUILDING 473 ECONOMIZER CONTROLS FOR AHU LOCATED							
ON THIRD FLOOR HALLWAY SOUTH END							
ELECTRIC CONTROLLER	1	EA	104.00	$104	24.00	$24	$128
MIXED AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
OUTSIDE AIR TEMPERATURE SENSOR	1	EA	60.00	$60	19.40	$19	$79
MIXED AIR ELECTRIC DAMPER MOTOR	1	EA	148.00	$148	25.00	$25	$173
SUBTOTAL				$744		$176	$920
CONTINGENCY 10%			10%	$74	10%	$18	$92
SUBTOTAL				$818		$194	$1,012
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$29	13.0%	$25	$54
DIRECT COST				$847		$219	$1,066
OVERHEAD AND PROFIT			25%	$212	25%	$55	$267
SUBTOTAL				$1,059		$274	$1,333
CONSTRUCTION COST							$1,333

ENG. FORM 150
1AVC-59

ECO-M2

DRY-BULB ECONOMIZER CONTROLS

BUILDING 463

ECO-M2 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION BASE ENERGY (THERMS)	STEAM CONSUMPTION ECO-M2 LOAD (THERMS)	STEAM CONSUMPTION ENERGY SAVINGS (MBTU)	ELECTRIC CONSUMPTION BASE LOAD (KW)	ELECTRIC CONSUMPTION ECO-M2 LOAD (KW)	ELECTRIC CONSUMPTION ENERGY SAVINGS (MBTU)	TOTAL SAVINGS ($)
463	1,577	1,577	0	83,903	83,831	0	$3
464	2,195	2,206	-1	91,802	88,123	13	$152
473	2,407	2,407	0	148,420	148,250	1	$7
							$162

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**                                                                         **
**            T R A C E   U L T R A   A N A L Y S I S                      **
**                                                                         **
**              by  CLARK RICHARDSON BISKUP                                **
**                                                                         **
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USDB ENERGY STUDY
LEAVENWORTH, KANSAS
USDB
BRIAN SCOTT

Weather File Code:	FTLVNWTH	
Location:	LEAVENWORTH, KANSAS (USDB)	
Latitude:	39.4	(deg)
Longitude:	94.9	(deg)
Time Zone:	6	
Elevation:	770	(ft)
Barometric Pressure:	29.1	(in. Hg)
Summer Clearness Number:	0.95	
Winter Clearness Number:	0.95	
Summer Design Dry Bulb:	96	(F)
Summer Design Wet Bulb:	77	(F)
Winter Design Dry Bulb:	3	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0739	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0837	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,770.2	(Btu-min./hr/cuft/lbm)
Enthalpy Factor:	4.4333	(Btu-min./hr/cuft)

Design Simulation Period: May To October
System Simulation Period: January To December
Cooling Load Methodology: CLTD/CLF (TFM)

Time/Date Program was Run: 15:11:24 9/19/90
Dataset Name: 463-AM .TM

AIRFLOW - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

SYSTEM SUMMARY
(Design Airflow Quantities)

System Number	System Type	Main: Outside Airflow (Cfm)	Main: Cooling Airflow (Cfm)	Main: Heating Airflow (Cfm)	Main: Return Airflow (Cfm)	Main: Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	FC	0	200	200	200	0	0	58
2	FC	0	630	630	630	0	0	45
3	FC	0	1,580	1,580	1,580	0	0	265
4	FC	0	600	600	600	0	0	45
5	FC	0	300	300	300	0	0	99
6	SZ	0	2,280	2,280	2,280	2,280	0	559
7	SZ	0	2,690	2,690	2,690	2,690	0	673
Totals		0	8,280	8,280	8,280	4,970	0	1,743

CAPACITY - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

SYSTEM SUMMARY
(Design Capacity Quantities)

System Number	System Type	Cooling: Main Sys. Capacity (Tons)	Cooling: Aux. Sys. Capacity (Tons)	Cooling: Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Heating: Main Sys. Capacity (Btuh)	Heating: Aux. Sys. Capacity (Btuh)	Heating: Preheat Capacity (Btuh)	Heating: Reheat Capacity (Btuh)	Heating: Humidif. Capacity (Btuh)	Heating: Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	FC	0.4	0.0	0.0	0.4	-10,000	0	0	0	0	0	-10,000
2	FC	0.8	0.0	0.0	0.8	0	0	-2,561	0	0	0	-2,561
3	FC	3.7	0.0	0.0	3.7	-66,910	0	0	0	0	0	-66,910
4	FC	1.3	0.0	0.0	1.3	-30,000	0	0	0	0	0	-30,000
5	FC	0.7	0.0	0.0	0.7	-15,000	0	0	0	0	0	-15,000
6	SZ	6.8	0.0	0.0	6.8	-130,000	0	0	0	0	0	-130,000
7	SZ	8.8	0.0	0.0	8.8	-165,000	0	0	0	0	0	-165,000
Totals		22.5	0.0	0.0	22.5	-416,910	0	-2,561	0	0	0	-419,471

ENGINEERING CHECKS - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

ENGINEERING CHECKS

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling Cfm/ Sq Ft	Cooling Cfm/ Ton	Cooling Sq Ft /Ton	Cooling Btuh/ Sq Ft	Heating Cfm/ Sq Ft	Heating Btuh/ Sq Ft	Floor Area Sq Ft
1	Main	FC	0.00	1.02	480.0	470.4	25.51	1.02	-51.02	196
2	Main	FC	0.00	1.76	794.1	450.0	26.67	1.76	-7.17	357
3	Main	FC	0.00	1.76	429.3	244.0	49.18	1.76	-74.51	898
4	Main	FC	0.00	1.13	450.0	396.7	30.25	1.13	-56.71	529
5	Main	FC	0.00	0.90	450.0	502.5	23.88	0.90	-44.78	335
6	Main	SZ	0.00	1.00	336.6	336.7	35.64	1.00	-56.99	2,281
7	Main	SZ	0.00	1.18	305.1	258.7	46.38	1.18	-72.34	2,281

System 1 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	1,666	0		1,666	16.27	1,666	21.65	0	0	0.00
Glass Cond	444	0		444	4.34	444	5.77	-1,943	-1,943	10.80
Wall Cond	3,265	470		3,736	36.48	3,265	42.44	-9,032	-10,548	58.67
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-1,404	-1,404	7.81
Infiltration	3,349			3,349	32.71	1,131	14.70	-4,085	-4,085	22.72
Sub Total==>	8,725	470		9,195	89.79	6,507	84.57	-16,464	-17,980	100.00
Internal Loads										
Lights	311	208		519	5.07	311	4.05	0	0	0.00
People	388			388	3.79	198	2.57	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	699	208	0	907	8.85	509	6.62	0	0	0.00
Ceiling Load	678	-678		0	0.00	678	8.81	-1,516	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				123	1.20		0.00		0	0.00
Ret. Fan Heat		16		16	0.16		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	10,102	16	0	10,240	100.00	7,694	100.00	-17,980	-17,980	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.4	5.0	3.8	200	78.2	61.2	55.9	42.1	41.1	37.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.4	5.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	196		
Part	0		
ExFlr	27		
Roof	0	0	0
Wall	393	48	12

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-10.0	200	68.0	151.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	200	68.0	41.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-10.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	58	58
Supply	200	200
Mincfm	200	200
Return	200	200
Exhaust	58	0
Rm Exh	58	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.02
Clg Cfm/Ton	480.00
Clg Sqft/Ton	470.40
Clg Btuh/Sqft	25.51
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	1.02
Htg Btuh/SqFt	-51.02

TEMPERATURES (F)

Type	Clg	Htg
SADB	42.5	151.0
Plenum	88.9	43.6
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 2 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	Cooling Coil Peak					Clg Space Peak		Heating Coil Peak		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	0	0		0	0.00	0	0.00	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	2,786			2,786	51.33	2,054	52.95	-7,418	-7,418	132.63
Sub Total==>	2,786	0		2,786	51.33	2,054	52.95	-7,418	-7,418	132.63
Internal Loads										
Lights	819	546		1,365	25.15	819	21.11	819	1,365	-24.41
People	840			840	15.48	460	11.86	460	460	-8.22
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	1,659	546	0	2,205	40.63	1,279	32.97	1,279	1,825	-32.63
Ceiling Load	546	-546		0	0.00	546	14.08	546	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				386	7.12		0.00		0	0.00
Ret. Fan Heat		50		50	0.93		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	4,991	50	0	5,428	100.00	3,879	100.00	-5,593	-5,593	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering Deg F	Entering Deg F	Entering Grains	Leaving Deg F	Leaving Deg F	Leaving Grains
					DB	WB	HR	DB	WB	HR
Main Clg	0.8	9.5	7.6	630	78.2	70.2	101.8	71.9	66.1	89.8
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.8	9.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	357		
Part	0		
ExFlr	0		
Roof	0	0	0
Wall	0	0	0

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	630	71.8	76.2
Aux Htg	0.0	0	0.0	0.0
Preheat	-2.6	630	68.0	71.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-2.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	105	105
Supply	630	630
Mincfm	630	630
Return	630	630
Exhaust	105	0
Rm Exh	45	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.76
Clg Cfm/Ton	794.12
Clg Sqft/Ton	450.00
Clg Btuh/Sqft	26.67
No. People	2
Htg % OA	0.0
Htg Cfm/SqFt	1.76
Htg Btuh/SqFt	-7.17

TEMPERATURES (F)

Type	Clg	Htg
SADB	72.3	76.2
Plenum	82.8	72.8
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 3 Block FC - FAN COIL

****** COOLING COIL PEAK ******						CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	5,753	0		5,753	9.36	5,753	14.94	0	0	0.00
Glass Cond	1,451	0		1,451	2.36	1,451	3.77	-6,346	-6,346	6.51
Wall Cond	3,260	412		3,673	5.98	3,260	8.47	-13,163	-16,719	17.15
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-3,120	-3,120	3.20
Infiltration	42,738			42,738	69.54	21,457	55.71	-77,482	-77,482	79.46
Sub Total==>	53,203	412		53,616	87.24	31,922	82.89	-100,111	-103,667	106.31
Internal Loads										
Lights	3,276	2,184		5,461	8.89	3,276	8.51	3,276	5,461	-5.60
People	1,288			1,288	2.10	718	1.86	690	690	-0.71
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	4,564	2,184	0	6,748	10.98	3,994	10.37	3,966	6,151	-6.31
Ceiling Load	2,597	-2,597		0	0.00	2,597	6.74	-1,372	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				969	1.58		0.00		0	0.00
Ret. Fan Heat		126		126	0.20		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	60,364	126	0	61,459	100.00	38,512	100.00	-97,517	-97,517	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	3.7	44.2	28.5	1,580	78.2	66.9	83.6	55.1	54.4	63.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	3.7	44.2								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	898		
Part	0		
ExFlr	60		
Roof	0	0	0
Wall	885	156	18

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-66.9	1,580	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	1,580	68.0	54.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-66.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	1,100	1,100
Supply	1,580	1,580
Mincfm	1,580	1,580
Return	1,580	1,580
Exhaust	1,100	0
Rm Exh	265	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.76
Clg Cfm/Ton	429.35
Clg Sqft/Ton	244.02
Clg Btuh/Sqft	49.18
No. People	3
Htg % OA	0.0
Htg Cfm/SqFt	1.76
Htg Btuh/SqFt	-74.51

TEMPERATURES (F)

Type	Clg	Htg
SADB	55.5	125.0
Plenum	87.1	63.2
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 4 Block FC - FAN COIL

******** COOLING COIL PEAK ********						CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/16					Mo/Hr: 7/16		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 75/105.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	5,933	0		5,933	25.14	5,933	32.71	0	0	0.00
Glass Cond	1,058	0		1,058	4.48	1,058	5.83	-4,656	-4,656	15.08
Wall Cond	3,010	532		3,542	15.01	3,010	16.60	-10,752	-13,300	43.06
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-1,872	-1,872	6.06
Infiltration	7,647			7,647	32.40	2,977	16.41	-11,059	-11,059	35.80
Sub Total==>	17,649	532		18,180	77.02	12,979	71.55	-28,339	-30,887	100.00
Internal Loads										
Lights	1,167	778		1,945	8.24	1,167	6.44	0	0	0.00
People	785			785	3.32	405	2.23	0	0	0.00
Misc	2,278	0	0	2,278	9.65	2,278	12.56	0	0	0.00
Sub Total==>	4,230	778	0	5,008	21.22	3,850	21.23	0	0	0.00
Ceiling Load	1,310	-1,310		0	0.00	1,310	7.22	-2,548	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				368	1.56		0.00		0	0.00
Ret. Fan Heat		48		48	0.20		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	23,189	48	0	23,604	100.00	18,139	100.00	-30,887	-30,887	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	1.3	16.0	12.6	600	78.2	62.4	61.4	49.7	48.6	50.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.3	16.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	529		
Part	0		
ExFlr	36		
Roof	0	0	0
Wall	538	114	21

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-30.0	600	68.0	115.5
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	600	68.0	49.5
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-30.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	157	157
Supply	600	600
Mincfm	600	600
Return	600	600
Exhaust	157	0
Rm Exh	45	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.13
Clg Cfm/Ton	450.00
Clg Sqft/Ton	396.75
Clg Btuh/Sqft	30.25
No. People	2
Htg % OA	0.0
Htg Cfm/SqFt	1.13
Htg Btuh/SqFt	-56.71

TEMPERATURES (F)

Type	Clg	Htg
SADB	50.1	115.5
Plenum	85.8	52.8
Return	78.0	68.0
Ret/CA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 5 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/14					Mo/Hr: 7/14		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	1,699	0		1,699	16.21	1,699	23.06	0	0	0.00
Glass Cond	315	0		315	3.01	315	4.28	-1,445	-1,445	10.61
Wall Cond	915	123		1,038	9.91	915	12.42	-3,362	-4,162	30.56
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-1,040	-1,040	7.64
Infiltration	4,402			4,402	42.00	1,877	25.48	-6,973	-6,973	51.20
Sub Total==>	7,332	123		7,455	71.12	4,807	65.24	-12,820	-13,620	100.00
Internal Loads										
Lights	1,229	819		2,048	19.54	1,229	16.67	0	0	0.00
People	771			771	7.36	391	5.31	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	2,000	819	0	2,819	26.89	1,620	21.98	0	0	0.00
Ceiling Load	942	-942		0	0.00	942	12.78	-800	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	1.75		0.00		0	0.00
Ret. Fan Heat		24		24	0.23		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	10,273	24	0	10,481	100.00	7,369	100.00	-13,620	-13,620	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.7	8.0	5.8	300	78.2	65.1	74.6	55.0	54.2	63.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.7	8.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	335		
Part	0		
ExFlr	20		
Roof	0	0	0
Wall	290	35	12

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-15.0	300	68.0	109.9
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	54.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-15.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	99	99
Supply	300	300
Mincfm	300	300
Return	300	300
Exhaust	99	0
Rm Exh	99	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.90
Clg Cfm/Ton	450.00
Clg Sqft/Ton	502.50
Clg Btuh/Sqft	23.88
No. People	2
Htg % OA	0.0
Htg Cfm/SqFt	0.90
Htg Btuh/SqFt	-44.78

TEMPERATURES (F)

Type	Clg	Htg
SADB	55.3	109.9
Plenum	86.9	60.5
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 6 Peak SZ - SINGLE ZONE

************************ COOLING COIL PEAK						CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	18,068	0		18,068	27.77	18,068	39.69	0	0	0.00
Glass Cond	4,015	0		4,015	6.17	4,015	8.82	-17,556	-17,556	24.26
Wall Cond	2,711	975		3,687	5.67	2,711	5.96	-9,374	-15,511	21.43
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	25,366			25,366	38.99	10,884	23.91	-39,305	-39,305	54.31
Sub Total==>	50,160	975		51,136	78.59	35,679	78.37	-66,234	-72,372	100.00
Internal Loads										
Lights	9,182	6,122		15,304	23.52	9,182	20.17	0	0	0.00
People	3,878			3,878	5.96	1,978	4.34	0	0	0.00
Misc	7,818	0	0	7,818	12.02	7,818	17.17	0	0	0.00
Sub Total==>	20,878	6,122	0	27,000	41.50	18,978	41.69	0	0	0.00
Ceiling Load	7,097	-7,097		0	0.00	7,097	15.59	-6,137	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				2,795	4.30		0.00		0	0.00
Ret. Fan Heat		363		363	0.56		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	-16,230			-16,230	-24.95	-16,230	-35.65	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	61,905	363	0	65,064	100.00	45,524	100.00	-72,372	-72,372	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	6.8	81.3	64.9	2,280	78.0	64.9	73.9	58.4	53.0	52.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	6.8	81.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	2,281		
Part	0		
ExFlr	0		
Roof	0	0	0
Wall	1,752	430	25

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-130.0	2,280	68.0	97.3
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	2,280	68.0	58.4
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-130.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	558	558
Supply	2,280	2,280
Mincfm	2,280	2,280
Return	2,279	2,280
Exhaust	2,280	0
Rm Exh	559	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.00
Clg Cfm/Ton	336.55
Clg Sqft/Ton	336.70
Clg Btuh/Sqft	35.64
No. People	10
Htg % OA	0.0
Htg Cfm/SqFt	1.00
Htg Btuh/SqFt	-56.99

TEMPERATURES (F)

Type	Clg	Htg
SADB	59.6	97.3
Plenum	87.8	59.5
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

System 7 Peak SZ - SINGLE ZONE

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	20,531	0		20,531	24.54	20,531	37.88	-20,375	-20,375	0.00
Glass Solar	9,108	0		9,108	10.89	9,108	16.81	0	0	0.00
Glass Cond	2,361	0		2,361	2.82	2,361	4.36	-10,325	-10,325	9.88
Wall Cond	7,560	0		7,560	9.04	7,560	13.95	-26,278	-26,278	25.14
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	30,684			30,684	36.68	13,167	24.30	-47,546	-47,546	45.49
Sub Total==>	70,245	0		70,245	83.98	52,727	97.29	-104,523	-104,523	100.00
Internal Loads										
Lights	12,451	4,980		17,431	20.84	12,451	22.97	0	0	0.00
People	6,593			6,593	7.88	3,363	6.20	0	0	0.00
Misc	7,800	0	0	7,800	9.32	7,800	14.39	0	0	0.00
Sub Total==>	26,843	4,980	0	31,823	38.04	23,613	43.57	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				3,298	3.94		0.00		0	0.00
Ret. Fan Heat		429		429	0.51		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	-22,146			-22,146	-26.48	-22,146	-40.87	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	74,942	5,409	0	83,649	100.00	54,194	100.00	-104,523	-104,523	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	8.8	105.8	85.0	2,690	78.0	64.9	73.9	58.3	51.6	47.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	8.8	105.8								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	2,281		
Part	0		
ExFlr	0		
Roof	3,014	0	0
Wall	2,112	253	12

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-165.0	2,690	68.0	103.9
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	2,690	68.0	58.3
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-165.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	675	675
Supply	2,690	2,690
Mincfm	2,690	2,690
Return	2,690	2,690
Exhaust	2,690	0
Rm Exh	673	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.18
Clg Cfm/Ton	305.12
Clg Sqft/Ton	258.73
Clg Btuh/Sqft	46.38
No. People	17
Htg % OA	0.0
Htg Cfm/SqFt	1.18
Htg Btuh/SqFt	-72.34

TEMPERATURES (F)

Type	Clg	Htg
SADB	59.4	103.9
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	STEAM (Therm)
Jan	6,235	26	374
Feb	5,554	26	334
March	6,324	26	261
April	5,332	26	9
May	5,819	25	0
June	9,000	44	0
July	11,452	49	0
Aug	10,183	45	0
Sept	6,813	41	0
Oct	5,604	25	0
Nov	5,598	26	96
Dec	5,918	26	503
Total	83,831	49	1,577

Building Energy Consumption = 64,532 (Btu/Sq Ft/Year)   Floor Area = 6,877 (Sq Ft)
Source Energy Consumption = 155,397 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	3689	3286	3819	3512	3819	3641	3560	3948	3382	3689	3512	3430	43,287
	PK	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
1	MISC LD													
	ELEC	1030	909	1090	969	1090	1046	984	1169	923	1030	969	909	12,118
	PK	5.8	5.8	5.8	5.8	5.8	5.9	5.9	5.9	5.9	5.8	5.8	5.8	5.9
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1121S		AC RECIP CHILLER 20-60 T											
	ELEC	0	0	0	0	0	2088	3731	2568	917	0	0	0	9,303
	PK	0.0	0.0	0.0	0.0	0.0	12.7	16.1	13.4	10.8	0.0	0.0	0.0	16.1
1	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	0	254	491	317	107	0	0	0	1,168
	PK	0.0	0.0	0.0	0.0	0.0	1.6	2.4	1.7	1.5	0.0	0.0	0.0	2.4
1	EQ5001		CHILLED WATER PUMP C.V.											
	ELEC	0	0	0	0	0	168	180	176	94	0	0	0	619
	PK	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.5
1	EQ5313		CONTROLS											
	ELEC	0	0	0	0	0	95	102	100	53	0	0	0	351
	PK	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.3
2	EQ1170S		AC COND COMP <20 TONS											
	ELEC	0	0	0	0	0	547	878	594	382	0	0	0	2,400
	PK	0.0	0.0	0.0	0.0	0.0	3.5	3.7	3.5	3.1	0.0	0.0	0.0	3.7
2	EQ5200		CONDENSER FANS											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

	ELEC	0	0	0	0	0	61	116	69	36	0	0	0	283
	PK	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.3	0.0	0.0	0.0	0.4
2	EQ5313		CONTROLS											
	ELEC	0	0	0	0	0	97	102	101	88	0	0	0	388
	PK	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.3
1	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	18	16	17	10	10	13	18	16	8	13	14	18	170
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	56	50	56	54	56	54	56	56	54	56	54	56	658
	PK	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	EQ4381		PROPELLER FAN											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	140	127	140	136	140	136	140	140	136	140	136	140	1,650
	PK	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
4	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	45	41	43	28	29	32	48	36	25	38	37	48	451
	PK	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	EQ4381		PROPELLER FAN											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	19	18	19	13	15	15	24	19	14	14	13	20	203
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
6	EQ4003		FC CENTRIF. FAN C.V.											
	ELEC	409	365	377	269	303	341	443	399	278	286	272	444	4,185
	PK	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
7	EQ4003		FC CENTRIF. FAN C.V.											
	ELEC	538	481	509	322	357	412	579	476	314	337	391	564	5,281
	PK	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
1	CONVERTR		STEAM TO HOT WATER CONVERTER											
	P STEAM	341	304	237	9	0	0	0	0	0	0	96	456	1,443
	PK	2.5	2.5	2.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.6	2.6
1	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	138	125	121	9	0	0	0	0	0	0	96	138	628
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
1	EQ5060		CONDENSATE RETURN PUMP											
	ELEC	150	136	132	10	0	0	0	0	0	0	104	150	683
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
2	EQ2101		PURCHASED DISTRICT STEAM											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

	P STEAM	33	30	24	0	0	0	0	0	0	0	0	47	134
	PK	0.4	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
2	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	1	2
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5061		CONDENSATE RETURN PUMP											
	ELEC	1	1	1	0	0	0	0	0	0	0	0	1	3
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 3
BASE LOAD

UTILITY PEAK CHECKSUMS

Utility ELECTRIC DEMAND

Peak Value 48.7 (kW)
Yearly Time of Peak 15 (hr) 7 (mo)

Hour 15 Month 7

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1121S	AC RECIP CHILLER 20-60 T	19.3	39.56
2	EQ1170S	AC COND COMP <20 TONS	4.5	9.22
Sub Total			23.8	48.78
Sub Total			0.0	******
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.11
2		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.35
3		SUMMATION OF FAN ELECTRICAL DEMAND	0.4	0.88
4		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.34
5		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.17
6		SUMMATION OF FAN ELECTRICAL DEMAND	1.7	3.45
7		SUMMATION OF FAN ELECTRICAL DEMAND	2.0	4.07
Sub Total			4.6	9.38
Sub Total			0.0	0.00
Miscellaneous				
Lights			14.5	29.66
Base Utilities			0.0	0.00
Misc Equipment			5.9	12.19
Sub Total			20.4	41.84
Grand Total			48.7	100.00

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 3
BASE LOAD

CALIFORNIA TITLE 24 COMPLIANCE REPORT

Weather Name .... FTLVNWTH
Gross Conditioned Floor Area (sqft)...... 6,877
ACM Multiplier 1.008

ENERGY USE SUMMARY

	ELEC (kWh/yr)	DISTRICT STEAM (kBtu/yr)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	686.1	157,672.9	36.1	217,256.3	31.8
Primary Cooling					
Compressor	11,703.4	0.0	9.0	119,843.2	17.6
Tower/Cond Fans	1,451.1	0.0	1.1	14,859.2	2.2
Condenser Pump	0.0	0.0	0.0	0.0	0.0
Other Accessories	739.2	0.0	0.6	7,569.4	1.1
Auxiliary					
Supply Fans	12,598.3	0.0	9.7	129,007.3	18.9
Circulation Pumps	1,248.4	0.0	1.0	12,783.8	1.9
Base Utilities	0.0	0.0	0.0	0.0	0.0
Subtotal	13,846.7	0.0	10.6	141,791.0	20.8
Lighting	43,286.5	0.0	33.3	443,255.1	65.0
Receptacle	12,118.2	0.0	9.3	124,091.0	18.2
Domestic Hot Water	0.0	0.0	0.0	0.0	0.0
Cogeneration	0.0	0.0	0.0	0.0	0.0
Totals	83,331.3	157,672.9	100.0	1,068,665.3	156.6

ECO-M2

DRY-BULB ECONOMIZER CONTROLS

BUILDING 464

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**                                                                       **
**             T R A C E   U L T R A   A N A L Y S I S                   **
**                                                                       **
**               by  CLARK RICHARDSON BISKUP                             **
**                                                                       **
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USDB ENERGY STUDY
LEAVENWORTH, KANSAS
USDB
BRIAN SCOTT

Weather File Code:	FTLVNWTH	
Location:	LEAVENWORTH, KANSAS (USDB)	
Latitude:	39.4	(deg)
Longitude:	94.9	(deg)
Time Zone:	6	
Elevation:	770	(ft)
Barometric Pressure:	29.1	(in. Hg)
Summer Clearness Number:	0.95	
Winter Clearness Number:	0.95	
Summer Design Dry Bulb:	96	(F)
Summer Design Wet Bulb:	77	(F)
Winter Design Dry Bulb:	3	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0739	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0837	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,770.2	(Btu-min./hr/cuft/lbm)
Enthalpy Factor:	4.4333	(Btu-min./hr/cuft)

Design Simulation Period: May To October
System Simulation Period: January To December
Cooling Load Methodology: CLTD/CLF (TFM)

Time/Date Program was Run: 17:11:25 9/24/90
Dataset Name: 464-M .TM

AIRFLOW - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

SYSTEM SUMMARY
(Design Airflow Quantities)

System Number	System Type	Main: Outside Airflow (Cfm)	Main: Cooling Airflow (Cfm)	Main: Heating Airflow (Cfm)	Main: Return Airflow (Cfm)	Main: Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	SZ	0	2,027	1,110	2,027	2,027	0	495
2	SZ	0	300	232	300	0	0	124
3	FC	0	4,373	1,620	4,373	4,373	0	100
4	FC	0	300	301	300	0	0	50
5	FC	0	300	155	300	0	0	37
6	FC	0	300	200	299	0	0	48
7	FC	0	300	157	300	0	0	37
8	FC	0	893	299	893	0	0	78
9	FC	0	656	216	655	0	0	35
10	FC	0	300	230	300	0	0	55
11	FC	0	646	207	646	0	0	49
12	FC	0	300	204	299	0	0	49
13	FC	0	581	226	581	0	0	37
Totals		0	11,275	5,158	11,273	6,400	0	1,191

CAPACITY - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

SYSTEM SUMMARY
(Design Capacity Quantities)

System Number	System Type	Cooling: Main Sys. Capacity (Tons)	Cooling: Aux. Sys. Capacity (Tons)	Cooling: Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Heating: Main Sys. Capacity (Btuh)	Heating: Aux. Sys. Capacity (Btuh)	Heating: Preheat Capacity (Btuh)	Heating: Reheat Capacity (Btuh)	Heating: Humidif. Capacity (Btuh)	Heating: Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	SZ	5.2	0.0	0.0	5.2	-68,559	0	0	0	0	0	-68,559
2	SZ	1.6	0.0	0.0	1.6	-14,302	0	0	0	0	0	-14,302
3	FC	8.1	0.0	0.0	8.1	-100,085	0	0	0	0	0	-100,085
4	FC	1.5	0.0	0.0	1.5	-18,589	0	0	0	0	0	-18,589
5	FC	0.9	0.0	0.0	0.9	-9,595	0	0	0	0	0	-9,595
6	FC	0.9	0.0	0.0	0.9	-12,373	0	0	0	0	0	-12,373
7	FC	0.7	0.0	0.0	0.7	-9,674	0	0	0	0	0	-9,674
8	FC	1.5	0.0	0.0	1.5	-18,449	0	0	0	0	0	-18,449
9	FC	1.0	0.0	0.0	1.0	-13,357	0	0	0	0	0	-13,357
10	FC	1.4	0.0	0.0	1.4	-14,226	0	0	0	0	0	-14,226
11	FC	1.0	0.0	0.0	1.0	-12,772	0	0	0	0	0	-12,772
12	FC	1.0	0.0	0.0	1.0	-12,618	0	0	0	0	0	-12,618
13	FC	0.9	0.0	0.0	0.9	-13,987	0	0	0	0	0	-13,987
Totals		25.8	0.0	0.0	25.8	-318,586	0	0	0	0	0	-318,586

ENGINEERING CHECKS - ALTERNATIVE 3
ECO M2: DRY-BULB ECONOMIZER CONTROLS

ENGINEERING CHECKS

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling Cfm/ Sq Ft	Cooling Cfm/ Ton	Cooling Sq Ft /Ton	Cooling Btuh/ Sq Ft	Heating Cfm/ Sq Ft	Heating Btuh/ Sq Ft	Floor Area Sq Ft
1	Main	SZ	0.00	1.03	390.0	377.2	31.82	0.57	-34.98	1,960
2	Main	SZ	0.00	0.61	184.7	301.6	39.78	0.47	-29.19	490
3	Main	FC	0.00	2.03	538.8	264.9	45.30	0.75	-46.55	2,150
4	Main	FC	0.00	0.98	196.7	200.0	59.99	0.99	-60.95	305
5	Main	FC	0.00	1.88	348.1	185.7	64.63	0.97	-59.97	160
6	Main	FC	0.00	1.45	334.4	230.7	52.01	0.97	-59.78	207
7	Main	FC	0.00	1.88	409.2	218.2	54.99	0.98	-60.46	160
8	Main	FC	0.00	2.64	576.8	218.4	54.96	0.88	-54.58	338
9	Main	FC	0.00	4.37	688.1	157.5	76.21	1.44	-89.05	150
10	Main	FC	0.00	1.26	208.3	165.2	72.63	0.97	-59.77	238
11	Main	FC	0.00	3.06	643.3	210.1	57.12	0.98	-60.53	211
12	Main	FC	0.00	1.42	288.5	202.9	59.13	0.97	-59.80	211
13	Main	FC	0.00	3.63	668.2	184.1	65.17	1.42	-87.42	160

System 1 Peak SZ - SINGLE ZONE

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					*	Mo/Hr: 7/15		*	Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					*	OADB: 96		*	OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	5,746	0		5,746	9.21	*	5,746	12.59	*	0	0	0.00
Glass Cond	1,449	0		1,449	2.32	*	1,449	3.18	*	-6,338	-6,338	9.24
Wall Cond	4,788	341		5,129	8.22	*	4,788	10.49	*	-18,094	-20,383	29.73
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-6,760	-6,760	9.86
Infiltration	22,638			22,638	36.30	*	9,714	21.28	*	-35,078	-35,078	51.16
Sub Total==>	34,622	341		34,963	56.06	*	21,697	47.54	*	-66,270	-68,559	100.00
Internal Loads						*			*			
Lights	7,003	4,669		11,672	18.72	*	7,003	15.35	*	0	0	0.00
People	7,756			7,756	12.44	*	3,956	8.67	*	0	0	0.00
Misc	7,971	0	0	7,971	12.78	*	7,971	17.47	*	0	0	0.00
Sub Total==>	22,731	4,669	0	27,400	43.94	*	18,931	41.48	*	0	0	0.00
Ceiling Load	5,010	-5,010		0	0.00	*	5,010	10.98	*	-2,290	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				0	0.00	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	62,362	0	0	62,362	100.00	*	45,638	100.00	*	-68,559	-68,559	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	5.2	62.4	45.6	2,027	78.0	64.9	73.9	56.1	54.7	63.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	5.2	62.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	1,960		
Part	0		
ExFlr	130		
Roof	0	0	0
Wall	1,519	155	10

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-68.6	1,110	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	2,027	68.0	56.1
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-68.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	498	498
Supply	2,027	1,110
Mincfm	0	0
Return	2,027	1,110
Exhaust	2,027	0
Rm Exh	495	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.03
Clg Cfm/Ton	389.99
Clg Sqft/Ton	377.15
Clg Btuh/Sqft	31.82
No. People	20
Htg % OA	0.0
Htg Cfm/SqFt	0.57
Htg Btuh/SqFt	-34.98

TEMPERATURES (F)

Type	Clg	Htg
SADB	57.2	125.0
Plenum	86.1	64.3
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

System 2 Peak SZ - SINGLE ZONE

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	2,601		2,601	28.45	0	0.00	0	-2,966	0.00
Glass Solar	6,867	0		6,867	75.11	6,867	120.68	0	0	0.00
Glass Cond	1,364	0		1,364	14.92	1,364	23.96	-5,962	-5,962	41.69
Wall Cond	1,015	-34		981	10.73	1,015	17.84	-3,665	-4,125	28.85
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-1,248	-1,248	8.73
Infiltration	5,682			5,682	62.16	2,438	42.85	0	0	0.00
Sub Total==>	14,928	2,567		17,495	191.37	11,683	205.33	-10,875	-14,302	100.00
Internal Loads										
Lights	1,075	717		1,792	19.60	1,075	18.89	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	1,075	717	0	1,792	19.60	1,075	18.89	0	0	0.00
Ceiling Load	3,284	-3,284		0	0.00	3,284	57.71	-3,426	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	2.01		0.00		0	0.00
Ret. Fan Heat		24		24	0.26		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	-10,352			-10,352	******	-10,352	******	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	8,934	24	0	9,142	100.00	5,690	100.00	-14,302	-14,302	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.6	19.5	16.3	300	78.0	64.9	73.9	59.9	41.3	10.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.6	19.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	490		
Part	0		
ExFlr	24		
Roof	202	0	0
Wall	436	146	34

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-14.3	232	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	59.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-14.3			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	125	0
Supply	300	232
Mincfm	300	0
Return	300	232
Exhaust	125	0
Rm Exh	124	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.61
Clg Cfm/Ton	184.67
Clg Sqft/Ton	301.63
Clg Btuh/Sqft	39.78
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.47
Htg Btuh/SqFt	-29.19

TEMPERATURES (F)

Type	Clg	Htg
SADB	60.5	125.0
Plenum	99.2	45.9
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 3 Block FC - FAN COIL

************************ COOLING COIL PEAK						*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					*	Mo/Hr: 7/16		*	Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					*	OADB: 96		*	OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	9,844	0		9,844	10.11	*	9,604	11.88	*	0	0	0.00
Glass Cond	2,241	0		2,241	2.30	*	2,226	2.75	*	-9,798	-9,798	9.79
Wall Cond	13,534	1,046		14,580	14.97	*	14,104	17.44	*	-46,301	-51,827	51.78
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	24,820			24,820	25.49	*	10,354	12.81	*	-38,459	-38,459	38.43
Sub Total==>	50,439	1,046		51,485	52.87	*	36,289	44.88	*	-94,558	-100,085	100.00
Internal Loads						*			*			
Lights	6,848	4,565		11,413	11.72	*	6,848	8.47	*	0	0	0.00
People	5,817			5,817	5.97	*	3,036	3.76	*	0	0	0.00
Misc	28,671	0	0	28,671	29.44	*	28,997	35.87	*	0	0	0.00
Sub Total==>	41,336	4,565	0	45,901	47.13	*	38,880	48.09	*	0	0	0.00
Ceiling Load	5,611	-5,611		0	0.00	*	5,679	7.02	*	-5,527	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				0	0.00	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	97,386	0	0	97,386	100.00	*	80,848	100.00	*	-100,085	-100,085	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering Deg F	Entering Deg F	Entering Grains	Leaving Deg F	Leaving Deg F	Leaving Grains
					DB	WB	HR	DB	WB	HR
Main Clg	8.1	97.4	80.4	4,373	78.2	65.0	73.9	60.7	57.8	69.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	8.1	97.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	2,150		
Part	0		
ExFlr	0		
Roof	0	0	0
Wall	2,085	240	12

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-100.1	1,620	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	4,373	68.0	60.4
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-100.1			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	546	546
Supply	4,373	1,620
Mincfm	0	0
Return	4,373	1,620
Exhaust	4,373	0
Rm Exh	100	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	2.03
Clg Cfm/Ton	538.83
Clg Sqft/Ton	264.93
Clg Btuh/Sqft	45.30
No. People	15
Htg % OA	0.0
Htg Cfm/SqFt	0.75
Htg Btuh/SqFt	-46.55

TEMPERATURES (F)

Type	Clg	Htg
SADB	60.9	125.0
Plenum	86.2	59.9
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 4 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	7,581	0		7,581	41.43	7,581	53.53	-8,381	-8,381	0.00
Glass Solar	602	0		602	3.29	602	4.25	0	0	0.00
Glass Cond	234	0		234	1.28	234	1.65	-1,024	-1,024	5.51
Wall Cond	910	0		910	4.97	910	6.42	-4,254	-4,254	22.88
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	4,985			4,985	27.24	1,365	9.64	-4,931	-4,931	26.52
Sub Total==>	14,312	0		14,312	78.22	10,693	75.49	-18,589	-18,589	100.00
Internal Loads										
Lights	768	307		1,075	5.88	768	5.42	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	2,703	0	0	2,703	14.77	2,703	19.08	0	0	0.00
Sub Total==>	3,471	307	0	3,778	20.65	3,471	24.51	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	1.01		0.00		0	0.00
Ret. Fan Heat		24		24	0.13		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	17,783	331	0	18,298	100.00	14,164	100.00	-18,589	-18,589	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	1.5	18.3	14.7	300	78.2	56.7	36.1	34.1	28.8	16.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.5	18.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	305		
Part	0		
ExFlr	0		
Roof	377	0	0
Wall	174	25	14

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-18.6	301	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	33.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-18.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	70	70
Supply	300	301
Mincfm	300	0
Return	300	301
Exhaust	70	0
Rm Exh	50	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.98
Clg Cfm/Ton	196.74
Clg Sqft/Ton	200.02
Clg Btuh/Sqft	59.99
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.99
Htg Btuh/SqFt	-60.95

TEMPERATURES (F)

Type	Clg	Htg
SADB	34.4	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 5 Block FC - FAN COIL

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

Peaked at Time ==> Mo/Hr: 7/15 * Mo/Hr: 7/15 * Mo/Hr: 13/ 1
Outside Air ==> OADB/WB/HR: 96/ 77/112.0 * OADB: 96 * OADB: 3

Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	*	Space Sensible (Btuh)	Percnt Of Tot (%)	*	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	3,982	0		3,982	38.51	*	3,982	48.41	*	-4,402	-4,402	0.00
Glass Solar	302	0		302	2.92	*	302	3.68	*	0	0	0.00
Glass Cond	118	0		118	1.14	*	118	1.43	*	-514	-514	5.36
Wall Cond	443	0		443	4.29	*	443	5.39	*	-2,073	-2,073	21.61
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	2,024			2,024	19.57	*	722	8.77	*	-2,606	-2,606	27.16
Sub Total==>	6,869	0		6,869	66.43	*	5,567	67.67	*	-9,595	-9,595	100.00
Internal Loads						*			*			
Lights	1,038	415		1,453	14.05	*	1,038	12.61	*	0	0	0.00
People	388			388	3.75	*	198	2.40	*	0	0	0.00
Misc	1,424	0	0	1,424	13.77	*	1,424	17.31	*	0	0	0.00
Sub Total==>	2,849	415	0	3,264	31.56	*	2,659	32.33	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	1.78	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.23	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	9,718	439	0	10,341	100.00	*	8,226	100.00	*	-9,595	-9,595	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	0.9	10.3	8.8	300	78.2	62.2	60.4	52.3	49.8	50.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.9	10.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	160		
Part	0		
ExFlr	0		
Roof	198	0	0
Wall	85	13	15

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-9.6	155	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	52.1
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	37	37
Supply	300	155
Mincfm	300	0
Return	300	155
Exhaust	37	0
Rm Exh	37	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.88
Clg Cfm/Ton	348.14
Clg Sqft/Ton	185.67
Clg Btuh/Sqft	64.63
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.97
Htg Btuh/SqFt	-59.97

TEMPERATURES (F)

Type	Clg	Htg
SADB	52.7	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 6 Block FC - FAN COIL

************ COOLING COIL PEAK ************						*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/15		*		Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 3	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	5,148	0		5,148	47.82	*	5,148	61.79	*	-5,691	-5,691	0.00
Glass Solar	302	0		302	2.81	*	302	3.63	*	0	0	0.00
Glass Cond	118	0		118	1.09	*	118	1.41	*	-514	-514	4.16
Wall Cond	611	0		611	5.68	*	611	7.34	*	-2,858	-2,858	23.10
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	2,539			2,539	23.58	*	917	11.00	*	-3,311	-3,311	26.76
Sub Total==>	8,718	0		8,718	80.98	*	7,096	85.17	*	-12,373	-12,373	100.00
Internal Loads						*			*			
Lights	1,038	415		1,453	13.49	*	1,038	12.45	*	0	0	0.00
People	388			388	3.60	*	198	2.37	*	0	0	0.00
Misc	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sub Total==>	1,425	415	0	1,840	17.09	*	1,235	14.83	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	1.71	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.22	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	10,143	439	0	10,766	100.00	*	8,331	100.00	*	-12,373	-12,373	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.9	10.8	9.0	300	78.2	62.4	61.4	52.0	49.6	50.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.9	10.8								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	207		
Part	0		
ExFlr	0		
Roof	256	0	0
Wall	113	13	11

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-12.4	200	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	51.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-12.4			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	47	47
Supply	300	200
Mincfm	300	0
Return	299	200
Exhaust	47	0
Rm Exh	48	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.45
Clg Cfm/Ton	334.38
Clg Sqft/Ton	230.72
Clg Btuh/Sqft	52.01
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.97
Htg Btuh/SqFt	-59.78

TEMPERATURES (F)

Type	Clg	Htg
SADB	52.4	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 7 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	3,982	0		3,982	45.26	3,982	55.73	-4,402	-4,402	0.00
Glass Solar	302	0		302	3.44	302	4.23	0	0	0.00
Glass Cond	118	0		118	1.34	118	1.65	-514	-514	5.32
Wall Cond	460	0		460	5.23	460	6.44	-2,152	-2,152	22.24
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	1,861			1,861	21.15	722	10.10	-2,606	-2,606	26.94
Sub Total==>	6,722	0		6,722	76.41	5,584	78.15	-9,674	-9,674	100.00
Internal Loads										
Lights	768	307		1,075	12.22	768	10.75	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	793	0	0	793	9.01	793	11.10	0	0	0.00
Sub Total==>	1,561	307	0	1,868	21.23	1,561	21.85	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	2.09		0.00		0	0.00
Ret. Fan Heat		24		24	0.27		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	8,283	331	0	8,798	100.00	7,144	100.00	-9,674	-9,674	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.7	8.8	7.7	300	78.2	63.5	66.8	55.7	53.6	59.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.7	8.8								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	160		
Part	0		
ExFlr	0		
Roof	198	0	0
Wall	88	13	14

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-9.7	157	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	55.5
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.7			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	37	37
Supply	300	157
Mincfm	300	0
Return	300	157
Exhaust	37	0
Rm Exh	37	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.88
Clg Cfm/Ton	409.18
Clg Sqft/Ton	218.23
Clg Btuh/Sqft	54.99
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.98
Htg Btuh/SqFt	-60.46

TEMPERATURES (F)

Type	Clg	Htg
SADB	56.0	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 8 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				Mo/Hr: 7/15			Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				OADB: 96			OADB: 3	
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	9,407	0		9,407	50.64	9,407	61.39	-9,292	-9,292	0.00
Glass Solar	36	0		36	0.19	36	0.23	0	0	0.00
Glass Cond	118	0		118	0.63	118	0.77	-508	-508	2.75
Wall Cond	1,169	0		1,169	6.30	1,169	7.63	-3,154	-3,154	17.10
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	3,546			3,546	19.09	1,521	9.93	-5,494	-5,494	29.78
Sub Total==>	14,275	0		14,275	76.85	12,251	79.95	-18,449	-18,449	100.00
Internal Loads										
Lights	3,072	1,229		4,300	23.15	3,072	20.05	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	3,072	1,229	0	4,300	23.15	3,072	20.05	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				0	0.00		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	17,347	1,229	0	18,576	100.00	15,323	100.00	-18,449	-18,449	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB Deg F	Entering WB Deg F	Entering HR Grains	Leaving DB Deg F	Leaving WB Deg F	Leaving HR Grains
Main Clg	1.5	18.6	16.6	893	78.2	65.0	73.9	61.8	58.3	69.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.5	18.6								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	338		
Part	0		
ExFlr	0		
Roof	418	0	0
Wall	128	18	14

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-18.4	299	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	893	68.0	61.6
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-18.4			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	78	78
Supply	893	299
Mincfm	0	0
Return	893	299
Exhaust	78	0
Rm Exh	78	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	2.64
Clg Cfm/Ton	576.76
Clg Sqft/Ton	218.35
Clg Btuh/Sqft	54.96
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.88
Htg Btuh/SqFt	-54.58

TEMPERATURES (F)

Type	Clg	Htg
SADB	62.2	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 9 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

						*			*			
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/16		*		Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 3	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	4,568	0		4,568	39.96	*	4,442	42.68	*	-4,113	-4,113	0.00
Glass Solar	1,588	0		1,588	13.89	*	1,688	16.23	*	0	0	0.00
Glass Cond	235	0		235	2.06	*	234	2.25	*	-1,028	-1,028	7.70
Wall Cond	1,684	0		1,684	14.73	*	1,755	16.87	*	-5,821	-5,821	43.58
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	1,546			1,546	13.52	*	645	6.20	*	-2,395	-2,395	17.93
Sub Total==>	9,620	0		9,620	84.15	*	8,764	84.22	*	-13,357	-13,357	100.00
Internal Loads						*			*			
Lights	0	0		0	0.00	*	0	0.00	*	0	0	0.00
People	388			388	3.39	*	202	1.95	*	0	0	0.00
Misc	1,424	0	0	1,424	12.45	*	1,440	13.84	*	0	0	0.00
Sub Total==>	1,811	0	0	1,811	15.85	*	1,642	15.78	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				0	0.00	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	11,432	0	0	11,432	100.00	*	10,406	100.00	*	-13,357	-13,357	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.0	11.4	10.4	656	78.2	65.0	73.9	63.0	59.4	72.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.0	11.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	150		
Part	0		
ExFlr	0		
Roof	185	0	0
Wall	229	25	11

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-13.4	216	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	656	68.0	62.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-13.4			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	34	34
Supply	656	216
Mincfm	0	0
Return	655	216
Exhaust	34	0
Rm Exh	35	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	4.37
Clg Cfm/Ton	688.12
Clg Sqft/Ton	157.46
Clg Btuh/Sqft	76.21
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	1.44
Htg Btuh/SqFt	-89.05

TEMPERATURES (F)

Type	Clg	Htg
SADB	63.4	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 10 Block FC - FAN COIL

************************ COOLING COIL PEAK ****************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

						*			*			
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/15		*	Mo/Hr: 13/ 1		
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*	OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	7,260	0		7,260	42.00	*	7,260	51.26	*	-6,536	-6,536	0.00
Glass Solar	529	0		529	3.06	*	529	3.74	*	0	0	0.00
Glass Cond	118	0		118	0.68	*	118	0.83	*	-514	-514	3.61
Wall Cond	889	0		889	5.14	*	889	6.28	*	-3,302	-3,302	23.21
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	3,987			3,987	23.06	*	1,073	7.57	*	-3,874	-3,874	27.23
Sub Total==>	12,782	0		12,782	73.95	*	9,868	69.68	*	-14,226	-14,226	100.00
Internal Loads						*			*			
Lights	0	0		0	0.00	*	0	0.00	*	0	0	0.00
People	0			0	0.00	*	0	0.00	*	0	0	0.00
Misc	4,295	0	0	4,295	24.85	*	4,295	30.32	*	0	0	0.00
Sub Total==>	4,295	0	0	4,295	24.85	*	4,295	30.32	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	1.06	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.14	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	17,077	24	0	17,285	100.00	*	14,163	100.00	*	-14,226	-14,226	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.4	17.3	14.4	300	78.2	56.2	34.3	34.1	30.0	19.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.4	17.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	238		
Part	0		
ExFlr	0		
Roof	294	0	0
Wall	128	13	10

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-14.2	230	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	33.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-14.2			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	55	55
Supply	300	230
Mincfm	300	0
Return	300	230
Exhaust	55	0
Rm Exh	55	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.26
Clg Cfm/Ton	208.27
Clg Sqft/Ton	165.23
Clg Btuh/Sqft	72.63
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.97
Htg Btuh/SqFt	-59.77

TEMPERATURES (F)

Type	Clg	Htg
SADB	34.4	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 11 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/15		*		Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 3	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	6,445	0		6,445	53.47	*	6,445	59.63	*	-5,802	-5,802	0.00
Glass Solar	1,054	0		1,054	8.75	*	1,054	9.75	*	0	0	0.00
Glass Cond	234	0		234	1.94	*	234	2.17	*	-1,024	-1,024	8.02
Wall Cond	690	0		690	5.73	*	690	6.39	*	-2,564	-2,564	20.08
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	2,182			2,182	18.10	*	936	8.66	*	-3,381	-3,381	26.47
Sub Total==>	10,606	0		10,606	87.99	*	9,360	86.61	*	-12,772	-12,772	100.00
Internal Loads						*			*			
Lights	0	0		0	0.00	*	0	0.00	*	0	0	0.00
People	0			0	0.00	*	0	0.00	*	0	0	0.00
Misc	1,448	0	0	1,448	12.01	*	1,448	13.39	*	0	0	0.00
Sub Total==>	1,448	0	0	1,448	12.01	*	1,448	13.39	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				0	0.00	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	12,053	0	0	12,053	100.00	*	10,808	100.00	*	-12,772	-12,772	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.0	12.1	10.8	646	78.2	65.0	73.9	62.2	59.0	72.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.0	12.1								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	211		
Part	0		
ExFlr	0		
Roof	261	0	0
Wall	115	25	22

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-12.8	207	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	646	68.0	62.0
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-12.8			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	48	48
Supply	646	207
Mincfm	0	0
Return	646	207
Exhaust	48	0
Rm Exh	49	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	3.06
Clg Cfm/Ton	643.30
Clg Sqft/Ton	210.07
Clg Btuh/Sqft	57.12
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.98
Htg Btuh/SqFt	-60.53

TEMPERATURES (F)

Type	Clg	Htg
SADB	62.6	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 12 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	6,445	0		6,445	51.66	6,445	62.49	-5,802	-5,802	0.00
Glass Solar	529	0		529	4.24	529	5.13	0	0	0.00
Glass Cond	118	0		118	0.94	118	1.14	-514	-514	4.08
Wall Cond	786	0		786	6.30	786	7.63	-2,921	-2,921	23.15
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	2,892			2,892	23.18	936	9.08	-3,381	-3,381	26.80
Sub Total==>	10,770	0		10,770	86.32	8,814	85.47	-12,618	-12,618	100.00
Internal Loads										
Lights	0	0		0	0.00	0	0.00	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	1,499	0	0	1,499	12.01	1,499	14.53	0	0	0.00
Sub Total==>	1,499	0	0	1,499	12.01	1,499	14.53	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	1.47		0.00		0	0.00
Ret. Fan Heat		24		24	0.19		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	12,268	24	0	12,476	100.00	10,313	100.00	-12,618	-12,618	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	1.0	12.5	10.5	300	78.2	60.4	52.2	45.9	44.5	42.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.0	12.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	211		
Part	0		
ExFlr	0		
Roof	261	0	0
Wall	115	13	11

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-12.6	204	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	45.7
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-12.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	48	48
Supply	300	204
Mincfm	300	0
Return	299	204
Exhaust	48	0
Rm Exh	49	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.42
Clg Cfm/Ton	288.55
Clg Sqft/Ton	202.95
Clg Btuh/Sqft	59.13
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.97
Htg Btuh/SqFt	-59.80

TEMPERATURES (F)

Type	Clg	Htg
SADB	46.3	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 13 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

						*			*			
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/15		*		Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 3	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	4,889	0		4,889	46.89	*	4,889	51.64	*	-4,402	-4,402	0.00
Glass Solar	1,109	0		1,109	10.63	*	1,109	11.71	*	0	0	0.00
Glass Cond	235	0		235	2.26	*	235	2.48	*	-1,028	-1,028	7.35
Wall Cond	2,179	0		2,179	20.90	*	2,179	23.02	*	-5,951	-5,951	42.55
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	1,682			1,682	16.13	*	722	7.62	*	-2,606	-2,606	18.63
Sub Total==>	10,094	0		10,094	96.80	*	9,134	96.48	*	-13,987	-13,987	100.00
Internal Loads						*			*			
Lights	0	0		0	0.00	*	0	0.00	*	0	0	0.00
People	0			0	0.00	*	0	0.00	*	0	0	0.00
Misc	334	0	0	334	3.20	*	334	3.52	*	0	0	0.00
Sub Total==>	334	0	0	334	3.20	*	334	3.52	*	0	0	0.00
Ceiling Load	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				0	0.00	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	10,428	0	0	10,428	100.00	*	9,467	100.00	*	-13,987	-13,987	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	0.9	10.4	9.5	581	78.2	65.0	73.9	62.6	59.3	72.4
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.9	10.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	160		
Part	0		
ExFlr	0		
Roof	198	0	0
Wall	234	25	11

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-14.0	226	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	581	68.0	62.4
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-14.0			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	37	37
Supply	581	226
Mincfm	0	0
Return	581	226
Exhaust	37	0
Rm Exh	37	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	3.63
Clg Cfm/Ton	668.18
Clg Sqft/Ton	184.13
Clg Btuh/Sqft	65.17
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	1.42
Htg Btuh/SqFt	-87.42

TEMPERATURES (F)

Type	Clg	Htg
SADB	63.0	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	STEAM (Therm)
Jan	6,250	32	533
Feb	5,533	32	471
March	6,435	32	341
April	5,196	31	9
May	6,032	32	0
June	10,028	58	0
July	13,143	65	0
Aug	11,418	59	0
Sept	6,997	51	0
Oct	5,756	33	0
Nov	5,652	32	150
Dec	5,683	32	702
Total	88,123	65	2,206

Building Energy Consumption = 77,355 (Btu/Sq Ft/Year) Floor Area = 6,740 (Sq Ft)
Source Energy Consumption = 177,527 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	2157	1903	2284	2030	2284	2157	2030	2411	1903	2157	2030	1903	25,249
	PK	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
1	MISC LD													
	ELEC	2959	2611	3133	2785	3133	2972	2797	3322	2622	2959	2785	2611	34,691
	PK	16.7	16.7	16.7	16.7	16.7	16.8	16.8	16.8	16.8	16.7	16.7	16.7	16.8
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1121S	AC RECIP CHILLER 20-60 T												
	ELEC	0	0	0	0	0	3090	5720	3608	1367	0	0	0	13,785
	PK	0.0	0.0	0.0	0.0	0.0	21.4	27.5	22.5	15.0	0.0	0.0	0.0	27.5
1	EQ5200	CONDENSER FANS												
	ELEC	0	0	0	0	0	382	735	449	162	0	0	0	1,728
	PK	0.0	0.0	0.0	0.0	0.0	2.6	3.2	2.7	2.0	0.0	0.0	0.0	3.2
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	0	0	0	0	0	415	541	468	237	0	0	0	1,660
	PK	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.7
1	EQ5313	CONTROLS												
	ELEC	0	0	0	0	0	171	223	193	98	0	0	0	685
	PK	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.3
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	203	183	192	131	147	285	362	330	224	227	131	207	2,622
	PK	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5	1.5	1.5	0.8	0.8	1.5
2	EQ4371	FAN COIL SUPPLY FAN												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

	ELEC	23	20	18	11	13	32	46	37	20	13	14	26	272
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	116	104	105	71	214	235	289	268	189	173	74	123	1,961
	PK	0.4	0.4	0.4	0.4	1.2	1.2	1.2	1.2	1.2	1.2	0.4	0.4	1.2
4	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	33	30	30	16	16	20	25	21	14	43	25	36	309
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	17	15	15	8	16	19	25	20	10	20	13	18	197
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
6	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	22	20	20	11	15	19	27	20	9	32	17	24	235
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	17	16	16	8	16	18	26	20	9	23	13	19	200
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
8	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	31	27	27	15	48	55	78	61	28	27	22	33	453
	PK	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2
9	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	21	19	18	10	35	45	60	53	28	17	14	23	343
	PK	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2
10	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	20	17	17	12	16	19	24	23	15	14	13	23	213
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	19	17	16	10	35	36	54	46	26	28	12	21	320
	PK	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2
12	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	19	17	16	10	16	18	26	22	14	12	12	21	204
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	23	20	20	11	26	39	56	47	23	12	15	25	316
	PK	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2
1	CONVERTR		STEAM TO HOT WATER CONVERTER											
	P STEAM	533	471	341	9	0	0	0	0	0	0	150	702	2,206
	PK	2.5	2.5	2.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.6	2.6
1	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	273	246	244	27	0	0	0	0	0	0	221	273	1,284
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
1	EQ5060		CONDENSATE RETURN PUMP											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
BASE LOAD

ELEC	296	268	265	29	0	0	0	0	0	0	241	296	1,395
PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4

UTILITY PEAK CHECKSUMS - ALTERNATIVE 3
BASE LOAD

UTILITY PEAK CHECKSUMS

Utility ELECTRIC DEMAND

Peak Value 64.8 (kW)
Yearly Time of Peak 15 (hr) 7 (mo)

Hour 15 Month 7

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1121S	AC RECIP CHILLER 20-60 T	31.7	49.00
Sub Total			31.7	49.00
Sub Total			0.0	******
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	1.5	2.31
2		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
3		SUMMATION OF FAN ELECTRICAL DEMAND	1.2	1.84
4		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
5		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
6		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
7		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
8		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.38
9		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.28
10		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
11		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.27
12		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.13
13		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.24
Sub Total			4.0	6.20
Sub Total			0.0	0.00
Miscellaneous				
Lights			12.2	18.83
Base Utilities			0.0	0.00
Misc Equipment			16.8	25.97
Sub Total			29.0	44.81
Grand Total			64.8	100.00

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 3
BASE LOAD

CALIFORNIA TITLE 24 COMPLIANCE REPORT

Weather Name .... FTLVNWTH
Gross Conditioned Floor Area (sqft)...... 6,740
ACM Multiplier 1.008

ENERGY USE SUMMARY

	ELEC (kWh/yr)	DISTRICT STEAM (kBtu/yr)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	1,395.4	220,607.6	43.2	308,432.5	46.1
Primary Cooling					
Compressor	13,784.9	0.0	9.0	141,157.5	21.1
Tower/Cond Fans	1,727.7	0.0	1.1	17,692.0	2.6
Condenser Pump	0.0	0.0	0.0	0.0	0.0
Other Accessories	685.5	0.0	0.4	7,019.5	1.0
Auxiliary					
Supply Fans	7,645.7	0.0	5.0	78,292.1	11.7
Circulation Pumps	2,943.8	0.0	1.9	30,144.7	4.5
Base Utilities	0.0	0.0	0.0	0.0	0.0
Subtotal	10,589.5	0.0	6.9	108,436.8	16.2
Lighting	25,249.1	0.0	16.5	258,551.6	38.7
Receptacle	34,691.2	0.0	22.7	355,238.9	53.1
Domestic Hot Water	0.0	0.0	0.0	0.0	0.0
Cogeneration	0.0	0.0	0.0	0.0	0.0
Totals	88,123.4	220,607.6	100.0	1,196,528.9	178.9

ECO-M2

DRY-BULB ECONOMIZER CONTROLS

BUILDING 473

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**                                                                          **
**            T R A C E   U L T R A   A N A L Y S I S                       **
**                                                                          **
**              by  CLARK RICHARDSON BISKUP                                 **
**                                                                          **
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USDB ENERGY STUDY
LEAVENWORTH, KANSAS
USDB
BRIAN SCOTT

Weather File Code:	FTLVNWTH
Location:	LEAVENWORTH, KANSAS (USDB)
Latitude:	39.4 (deg)
Longitude:	94.9 (deg)
Time Zone:	6
Elevation:	770 (ft)
Barometric Pressure:	29.1 (in. Hg)
Summer Clearness Number:	0.95
Winter Clearness Number:	0.95
Summer Design Dry Bulb:	96 (F)
Summer Design Wet Bulb:	77 (F)
Winter Design Dry Bulb:	3 (F)
Summer Ground Relectance:	0.20
Winter Ground Relectance:	0.20
Air Density:	0.0739 (Lbm/cuft)
Air Specific Heat:	0.2444 (Btu/lbm/F)
Density-Specific Heat Prod:	1.0837 (Btu-min./hr/cuft/F)
Latent Heat Factor:	4,770.2 (Btu-min./hr/cuft/lbm)
Enthalpy Factor:	4.4333 (Btu-min./hr/cuft)

Design Simulation Period: May To October
System Simulation Period: January To December
Cooling Load Methodology: CLTD/CLF (TFM)

Time/Date Program was Run: 9:58:45 9/25/90
Dataset Name: 473-M .TM

AIRFLOW - ALTERNATIVE 2
BASE LOAD

SYSTEM SUMMARY
(Design Airflow Quantities)

System Number	System Type	Main Outside Airflow (Cfm)	Main Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Main Return Airflow (Cfm)	Main Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	FC	0	400	304	400	0	0	50
2	FC	0	300	0	300	0	0	17
3	FC	0	800	0	800	0	0	137
4	FC	0	300	0	300	0	0	51
5	FC	0	300	53	300	0	0	23
6	FC	0	300	79	300	0	0	37
7	FC	0	300	0	300	0	0	30
8	FC	0	200	0	200	0	0	34
9	SZ	0	1,600	669	1,599	0	0	434
10	FC	0	600	209	600	0	0	98
11	SZ	0	4,910	2,541	4,910	4,910	0	1,037
12	SZ	0	5,900	2,929	5,900	5,900	0	1,183
Totals		0	15,910	6,783	15,908	10,810	0	3,132

CAPACITY - ALTERNATIVE 2
BASE LOAD

SYSTEM SUMMARY
(Design Capacity Quantities)

System Number	System Type	Cooling Main Sys. Capacity (Tons)	Cooling Aux. Sys. Capacity (Tons)	Cooling Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Heating Main Sys. Capacity (Btuh)	Heating Aux. Sys. Capacity (Btuh)	Heating Preheat Capacity (Btuh)	Heating Reheat Capacity (Btuh)	Heating Humidif. Capacity (Btuh)	Heating Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	FC	0.9	0.0	0.0	0.9	-18,767	0	0	0	0	0	-18,767
2	FC	0.6	0.0	0.0	0.6	0	0	-22,807	0	0	0	-22,807
3	FC	2.2	0.0	0.0	2.2	0	0	-47,137	0	0	0	-47,137
4	FC	0.8	0.0	0.0	0.8	0	0	-17,446	0	0	0	-17,446
5	FC	0.2	0.0	0.0	0.2	-3,024	0	-1,300	0	0	0	-4,325
6	FC	0.6	0.0	0.0	0.6	-4,858	0	0	0	0	0	-4,858
7	FC	0.4	0.0	0.0	0.4	0	0	-21,779	0	0	0	-21,779
8	FC	0.7	0.0	0.0	0.7	0	0	-9,923	0	0	0	-9,923
9	SZ	1.5	0.0	0.0	1.5	-40,932	0	-955	0	0	0	-41,887
10	FC	1.3	0.0	0.0	1.3	-12,027	0	-2,589	0	0	0	-14,616
11	SZ	13.7	0.0	0.0	13.7	-156,944	0	0	0	0	0	-156,944
12	SZ	16.0	0.0	0.0	16.0	-180,898	0	0	0	0	0	-180,898
Totals		38.9	0.0	0.0	38.9	-417,451	0	-123,936	0	0	0	-541,386

ENGINEERING CHECKS - ALTERNATIVE 2
BASE LOAD

ENGINEERING CHECKS

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling Cfm/ Sq Ft	Cooling Cfm/ Ton	Cooling Sq Ft /Ton	Cooling Btuh/ Sq Ft	Heating Cfm/ Sq Ft	Heating Btuh/ Sq Ft	Floor Area Sq Ft
1	Main	FC	0.00	0.69	444.4	643.3	18.65	0.52	-32.41	579
2	Main	FC	0.00	3.85	486.5	126.5	94.87	0.00	-292.39	78
3	Main	FC	0.00	1.30	371.0	286.1	41.94	0.00	-76.40	617
4	Main	FC	0.00	1.32	375.5	285.4	42.05	0.00	-76.52	228
5	Main	FC	0.00	2.88	1,420.3	492.4	24.37	0.51	-41.58	104
6	Main	FC	0.00	1.79	495.2	277.3	43.27	0.47	-28.92	168
7	Main	FC	0.00	2.19	837.8	382.6	31.36	0.00	-158.97	137
8	Main	FC	0.00	1.31	286.0	218.8	54.84	0.00	-64.86	153
9	Main	SZ	0.00	0.82	1,035.6	1,262.1	9.51	0.34	-21.48	1,950
10	Main	FC	0.00	1.36	464.5	340.6	35.23	0.48	-33.22	440
11	Main	SZ	0.00	1.17	359.0	306.2	39.19	0.61	-37.47	4,188
12	Main	SZ	0.00	1.41	368.7	261.7	45.85	0.70	-43.19	4,188

System 1 Block FC - FAN COIL

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

Peaked at Time ==> Mo/Hr: 7/15 * Mo/Hr: 7/16 * Mo/Hr: 13/ 1
Outside Air ==> OADB/WB/HR: 96/ 77/112.0 * OADB: 96 * OADB: 3

Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	*	Space Sensible (Btuh)	Percent Of Tot (%)	*	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	C	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	2,402	0		2,402	11.47	*	2,402	16.47	*	0	0	0.00
Glass Cond	732	0		732	3.49	*	727	4.98	*	-3,195	-3,195	17.02
Wall Cond	642	155		797	3.80	*	649	4.45	*	-2,255	-3,187	16.98
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-3,370	-3,370	17.95
Infiltration	7,057			7,057	33.70	*	2,427	16.64	*	-9,016	-9,016	48.04
Sub Total==>	10,833	155		10,988	52.47	*	6,206	42.53	*	-17,836	-18,767	100.00
Internal Loads						*			*			
Lights	2,117	1,411		3,528	16.85	*	2,117	14.51	*	0	0	0.00
People	3,102			3,102	14.82	*	1,619	11.10	*	0	0	0.00
Misc	3,045	0	0	3,045	14.54	*	3,080	21.11	*	0	0	0.00
Sub Total==>	8,264	1,411	0	9,676	46.20	*	6,816	46.72	*	0	0	0.00
Ceiling Load	1,566	-1,566		0	0.00	*	1,569	10.75	*	-931	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				245	1.17	*		0.00	*		0	0.00
Ret. Fan Heat		32		32	0.15	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	20,664	32	0	20,941	100.00	*	14,590	100.00	*	-18,767	-18,767	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.9	10.8	7.7	400	78.2	62.0	59.7	44.0	42.9	40.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.9	10.8								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	579		
Part	0		
ExFlr	65		
Roof	0	0	0
Wall	805	86	11

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-18.8	304	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	400	68.0	43.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-18.8			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	128	128
Supply	400	304
Mincfm	400	0
Return	400	304
Exhaust	128	0
Rm Exh	50	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.69
Clg Cfm/Ton	444.44
Clg Sqft/Ton	643.33
Clg Btuh/Sqft	18.65
No. People	8
Htg % OA	0.0
Htg Cfm/SqFt	0.52
Htg Btuh/SqFt	-32.41

TEMPERATURES (F)

Type	Clg	Htg
SADB	44.3	125.0
Plenum	86.5	62.9
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 2 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/16		Mo/Hr: 0/ 0		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 0		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	112	32		145	4.89	111	4.70	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	532			532	18.01	322	13.62	0	0	0.00
Sub Total==>	644	32		677	22.90	434	18.32	0	0	0.00
Internal Loads										
Lights	156	104		259	8.78	156	6.57	0	0	0.00
People	388			388	13.12	202	8.55	0	0	0.00
Misc	1,424	0	0	1,424	48.17	1,440	60.82	0	0	0.00
Sub Total==>	1,967	104	0	2,071	70.07	1,798	75.95	0	0	0.00
Ceiling Load	136	-136		0	0.00	136	5.74	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	6.22		0.00		0	0.00
Ret. Fan Heat		24		24	0.81		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	2,748	24	0	2,955	100.00	2,367	100.00	0	0	0.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.6	7.4	6.4	300	78.2	68.9	94.7	70.4	61.8	71.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.6	7.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	78		
Part	0		
ExFlr	8		
Roof	0	0	0
Wall	99	0	0

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-22.8	300	0.0	70.2
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-22.8			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	17	0
Supply	300	0
Mincfm	300	0
Return	300	0
Exhaust	17	0
Rm Exh	17	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	3.85
Clg Cfm/Ton	486.49
Clg Sqft/Ton	126.49
Clg Btuh/Sqft	94.87
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.00
Htg Btuh/SqFt	-292.39

TEMPERATURES (F)

Type	Clg	Htg
SADB	70.7	0.0
Plenum	83.5	0.0
Return	78.0	0.0
Ret/OA	78.0	0.0
Runarnd	78.0	0.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 3 Block FC - FAN COIL

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				Mo/Hr: 7/15			Mo/Hr: 0/ 0	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				OADB: 96			OADB: 0	
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	2,001	0		2,001	7.73	2,001	10.01	0	0	0.00
Glass Cond	406	0		406	1.57	406	2.03	0	0	0.00
Wall Cond	343	95		439	1.70	343	1.72	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	6,672			6,672	25.78	2,672	13.37	0	0	0.00
Sub Total==>	9,422	95		9,518	36.78	5,423	27.12	0	0	0.00
Internal Loads										
Lights	2,801	1,868		4,669	18.04	2,801	14.01	0	0	0.00
People	2,715			2,715	10.49	1,385	6.93	0	0	0.00
Misc	8,422	0	0	8,422	32.54	8,422	42.12	0	0	0.00
Sub Total==>	13,938	1,868	0	15,805	61.08	12,608	63.06	0	0	0.00
Ceiling Load	1,963	-1,963		0	0.00	1,963	9.82	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				490	1.90		0.00		0	0.00
Ret. Fan Heat		64		64	0.25		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	25,323	64	0	25,877	100.00	19,993	100.00	0	0	0.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	2.2	25.9	20.5	800	78.2	64.0	69.2	54.6	53.0	59.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	2.2	25.9								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	617		
Part	0		
ExFlr	41		
Roof	0	0	0
Wall	333	43	13

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-47.1	800	0.0	54.4
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-47.1			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	137	0
Supply	800	0
Mincfm	800	0
Return	800	0
Exhaust	137	0
Rm Exh	137	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.30
Clg Cfm/Ton	370.99
Clg Sqft/Ton	286.12
Clg Btuh/Sqft	41.94
No. People	7
Htg % OA	0.0
Htg Cfm/SqFt	0.00
Htg Btuh/SqFt	-76.40

TEMPERATURES (F)

Type	Clg	Htg
SADB	54.9	0.0
Plenum	88.0	0.0
Return	78.0	0.0
Ret/OA	78.0	0.0
Runarnd	78.0	0.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 4 Block FC - FAN COIL

************************ COOLING COIL PEAK ****************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

						*			*			
Peaked at Time ==>		Mo/Hr: 7/16				*	Mo/Hr: 7/16		*		Mo/Hr: 0/ 0	
Outside Air ==>		OADB/WB/HR: 96/ 75/105.0				*	OADB: 96		*		OADB: 0	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	C	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	2,136	0		2,136	22.29	*	2,136	27.64	*	0	0	0.00
Glass Cond	202	0		202	2.11	*	202	2.62	*	0	0	0.00
Wall Cond	230	46		276	2.88	*	230	2.98	*	0	0	0.00
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	2,047			2,047	21.36	*	967	12.51	*	0	0	0.00
Sub Total==>	4,616	46		4,662	48.63	*	3,536	45.75	*	0	0	0.00
Internal Loads						*			*			
Lights	1,245	830		2,075	21.65	*	1,245	16.11	*	0	0	0.00
People	1,177			1,177	12.28	*	607	7.86	*	0	0	0.00
Misc	1,464	0	0	1,464	15.27	*	1,464	18.95	*	0	0	0.00
Sub Total==>	3,886	830	0	4,716	49.20	*	3,316	42.91	*	0	0	0.00
Ceiling Load	876	-876		0	0.00	*	876	11.34	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	1.92	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.25	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
						*			*			
Grand Total==>	9,378	24	0	9,586	100.00	*	7,728	100.00	*	0	0	0.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	0.8	9.6	7.9	300	78.2	65.0	73.9	53.9	53.0	60.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.8	9.6								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	228		
Part	0		
ExFlr	19		
Roof	0	0	0
Wall	234	22	9

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-17.4	300	0.0	53.7
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-17.4			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	51	0
Supply	300	0
Mincfm	300	0
Return	300	0
Exhaust	51	0
Rm Exh	51	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.32
Clg Cfm/Ton	375.54
Clg Sqft/Ton	285.41
Clg Btuh/Sqft	42.05
No. People	3
Htg % OA	0.0
Htg Cfm/SqFt	0.00
Htg Btuh/SqFt	-76.52

TEMPERATURES (F)

Type	Clg	Htg
SADB	54.2	0.0
Plenum	90.1	0.0
Return	78.0	0.0
Ret/OA	78.0	0.0
Runarnd	78.0	0.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 5 Block FC - FAN COIL

************************ COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/15		*		Mo/Hr: 13/ 1	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 3	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Cond	191	0		191	7.55	*	191	10.83	*	-837	-837	25.72
Wall Cond	84	19		103	4.06	*	84	4.76	*	-243	-364	11.20
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-432	-432	13.27
Infiltration	1,009			1,009	39.79	*	449	25.39	*	-1,620	-1,620	49.81
Sub Total==>	1,284	19		1,303	51.40	*	724	40.98	*	-3,131	-3,253	100.00
Internal Loads						*			*			
Lights	614	410		1,024	40.40	*	614	34.77	*	0	0	0.00
People	0			0	0.00	*	0	0.00	*	0	0	0.00
Misc	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sub Total==>	614	410	0	1,024	40.40	*	614	34.77	*	0	0	0.00
Ceiling Load	428	-428		0	0.00	*	428	24.24	*	-121	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	7.26	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.94	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	2,327	24	0	2,535	100.00	*	1,767	100.00	*	-3,253	-3,253	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.2	2.5	2.0	300	78.2	65.4	76.3	72.2	62.9	73.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.2	2.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	104		
Part	0		
ExFlr	8		
Roof	0	0	0
Wall	102	20	20

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-3.0	53	72.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-1.3	300	68.0	72.0
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-4.3			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	23	23
Supply	300	53
Mincfm	300	0
Return	300	53
Exhaust	23	0
Rm Exh	23	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	2.88
Clg Cfm/Ton	1420.35
Clg Sqft/Ton	492.39
Clg Btuh/Sqft	24.37
No. People	0
Htg % OA	0.0
Htg Cfm/SqFt	0.51
Htg Btuh/SqFt	-41.58

TEMPERATURES (F)

Type	Clg	Htg
SADB	72.6	125.0
Plenum	91.0	64.3
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 6 Block FC - FAN COIL

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/14					Mo/Hr: 7/10		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 86		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	1,090	0		1,090	14.99	1,875	31.85	0	0	0.00
Glass Cond	194	0		194	2.67	97	1.65	-890	-890	18.31
Wall Cond	164	26		190	2.61	154	2.61	-440	-634	13.05
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-728	-728	14.99
Infiltration	1,746			1,746	24.03	337	5.72	-2,606	-2,606	53.65
Sub Total==>	3,194	26		3,221	44.31	2,462	41.83	-4,664	-4,858	100.00
Internal Loads										
Lights	1,229	819		2,048	28.17	1,180	20.04	0	0	0.00
People	385			385	5.30	173	2.93	0	0	0.00
Misc	1,407	0	0	1,407	19.36	1,262	21.44	0	0	0.00
Sub Total==>	3,022	819	0	3,841	52.84	2,614	44.41	0	0	0.00
Ceiling Load	845	-845		0	0.00	810	13.76	-194	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				184	2.53		0.00		0	0.00
Ret. Fan Heat		24		24	0.33		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	7,061	24	0	7,269	100.00	5,886	100.00	-4,858	-4,858	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.6	7.3	6.0	300	78.2	64.3	70.6	59.7	56.3	64.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.6	7.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	168		
Part	0		
ExFlr	14		
Roof	0	0	0
Wall	164	22	13

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-4.9	79	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	300	68.0	59.3
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-4.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	37	37
Supply	300	79
Mincfm	300	0
Return	300	79
Exhaust	37	0
Rm Exh	37	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.79
Clg Cfm/Ton	495.24
Clg Sqft/Ton	277.33
Clg Btuh/Sqft	43.27
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.47
Htg Btuh/SqFt	-28.92

TEMPERATURES (F)

Type	Clg	Htg
SADB	59.9	125.0
Plenum	93.9	64.4
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 7 Block FC - FAN COIL

********	COOLING COIL PEAK					*	CLG SPACE PEAK		*	HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/16		*		Mo/Hr: 0/ 0	
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*		OADB: 0	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	C	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Wall Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	1,114			1,114	25.93	*	578	17.03	*	0	0	0.00
Sub Total==>	1,114	0		1,114	25.93	*	578	17.03	*	0	0	0.00
Internal Loads						*			*			
Lights	663	442		1,106	25.74	*	672	19.78	*	0	0	0.00
People	397			397	9.24	*	209	6.16	*	0	0	0.00
Misc	1,472	0	0	1,472	34.26	*	1,488	43.84	*	0	0	0.00
Sub Total==>	2,533	442	0	2,975	69.24	*	2,369	69.78	*	0	0	0.00
Ceiling Load	442	-442		0	0.00	*	448	13.19	*	0	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				184	4.28	*		0.00	*		0	0.00
Ret. Fan Heat		24		24	0.56	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0			0	0.00	*	0	0.00	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	4,089	24	0	4,297	100.00	*	3,395	100.00	*	0	0	0.00

COOLING COIL SELECTION

	Total Capacity (Tons)	(Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.4	4.3	3.6	300	78.2	67.5	87.0	67.2	63.3	83.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.4	4.3								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	137		
Part	0		
ExFlr	0		
Roof	0	0	0
Wall	0	0	0

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-21.8	300	0.0	67.0
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-21.8			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	30	0
Supply	300	0
Mincfm	300	0
Return	300	0
Exhaust	30	0
Rm Exh	30	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	2.19
Clg Cfm/Ton	837.83
Clg Sqft/Ton	382.61
Clg Btuh/Sqft	31.36
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.00
Htg Btuh/SqFt	-158.97

TEMPERATURES (F)

Type	Clg	Htg
SADB	67.6	0.0
Plenum	88.2	0.0
Return	78.0	0.0
Ret/OA	78.0	0.0
Runarnd	78.0	0.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 8 Block FC - FAN COIL

************************ COOLING COIL PEAK ****************************** CLG SPACE PEAK *********** HEATING COIL PEAK ********

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/16				Mo/Hr: 7/16			Mo/Hr: 0/ 0	
Outside Air ==>		OADB/WB/HR: 96/ 75/105.0				OADB: 96			OADB: 0	
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	2,136	0		2,136	25.46	2,136	31.15	0	0	0.00
Glass Cond	202	0		202	2.41	202	2.95	0	0	0.00
Wall Cond	144	15		159	1.89	144	2.10	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	1,847			1,847	22.02	645	9.40	0	0	0.00
Sub Total==>	4,330	15		4,344	51.78	3,127	45.59	0	0	0.00
Internal Loads										
Lights	1,245	830		2,075	24.73	1,245	18.15	0	0	0.00
People	392			392	4.68	202	2.95	0	0	0.00
Misc	1,440	0	0	1,440	17.16	1,440	20.99	0	0	0.00
Sub Total==>	3,077	830	0	3,907	46.57	2,887	42.09	0	0	0.00
Ceiling Load	845	-845		0	0.00	845	12.32	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				123	1.46		0.00		0	0.00
Ret. Fan Heat		16		16	0.19		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	8,252	16	0	8,390	100.00	6,859	100.00	0	0	0.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	0.7	8.4	7.0	200	78.2	60.6	53.1	46.0	44.6	42.6
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	0.7	8.4								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	153		
Part	0		
ExFlr	14		
Roof	0	0	0
Wall	158	22	14

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	0.0	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-9.9	200	0.0	45.8
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	34	0
Supply	200	0
Mincfm	200	0
Return	200	0
Exhaust	34	0
Rm Exh	34	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.31
Clg Cfm/Ton	286.04
Clg Sqft/Ton	218.82
Clg Btuh/Sqft	54.84
No. People	1
Htg % OA	0.0
Htg Cfm/SqFt	0.00
Htg Btuh/SqFt	-64.86

TEMPERATURES (F)

Type	Clg	Htg
SADB	46.4	0.0
Plenum	95.4	0.0
Return	78.0	0.0
Ret/OA	78.0	0.0
Runarnd	78.0	0.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 9 Peak SZ - SINGLE ZONE

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	Space Sensible	Percnt Of Tot	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	3,853	0		3,853	20.78	3,853	26.71	0	0	0.00
Glass Cond	609	0		609	3.29	609	4.23	-2,665	-2,665	6.45
Wall Cond	1,075	439		1,514	8.17	1,075	7.45	-2,911	-4,100	9.92
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-4,066	-4,066	9.84
Infiltration	10,347			10,347	55.81	8,446	58.56	-30,500	-30,500	73.79
Sub Total==>	15,884	439		16,323	88.04	13,983	96.96	-40,142	-41,331	100.00
Internal Loads										
Lights	0	0		0	0.00	0	0.00	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	0	0	0	0	0.00	0	0.00	0	0	0.00
Ceiling Load	439	-439		0	0.00	439	3.04	-1,189	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				1,962	10.58		0.00		0	0.00
Ret. Fan Heat		255		255	1.37		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	16,323	255	0	18,540	100.00	14,422	100.00	-41,331	-41,331	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.5	18.5	16.6	1,600	78.0	70.8	105.6	68.6	67.7	103.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.5	18.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	1,950		
Part	0		
ExFlr	78		
Roof	0	0	0
Wall	977	65	7

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-40.9	669	68.6	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-1.0	1,600	68.0	68.6
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-41.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	433	433
Supply	1,600	669
Mincfm	1,600	0
Return	1,599	669
Exhaust	433	0
Rm Exh	434	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	0.82
Clg Cfm/Ton	1035.60
Clg Sqft/Ton	1262.13
Clg Btuh/Sqft	9.51
No. People	50
Htg % OA	0.0
Htg Cfm/SqFt	0.34
Htg Btuh/SqFt	-21.48

TEMPERATURES (F)

Type	Clg	Htg
SADB	69.7	125.0
Plenum	78.7	66.1
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

System 10 Block FC - FAN COIL

***** COOLING COIL PEAK *****						CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>		Mo/Hr: 7/15				Mo/Hr: 7/15		Mo/Hr: 13/ 1		
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				OADB: 96		OADB: 3		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	C	0	0.00
Roof Cond	0	0		0	0.00	0	0.00	0	0	0.00
Glass Solar	610	0		610	12.94	610	17.20	0	0	0.00
Glass Cond	300	0		300	6.36	300	8.45	-1,310	-1,310	10.13
Wall Cond	523	201		724	15.36	523	14.76	-1,717	-2,377	18.38
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-2,340	-2,340	18.10
Infiltration	2,665			2,665	56.53	1,912	53.92	-6,903	-6,903	53.39
Sub Total==>	4,097	201		4,298	91.18	3,344	94.33	-12,270	-12,930	100.00
Internal Loads										
Lights	0	0		0	0.00	0	0.00	0	0	0.00
People	0			0	0.00	0	0.00	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	0	0	0	0	0.00	0	0.00	0	0	0.00
Ceiling Load	201	-201		0	0.00	201	5.67	-660	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				368	7.80		0.00		0	0.00
Ret. Fan Heat		48		48	1.01		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	4,298	48	0	4,714	100.00	3,545	100.00	-12,930	-12,930	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Deg F	Grains	Leaving DB/WB/HR Deg F	Deg F	Grains
Main Clg	1.3	15.5	13.0	600	78.2	70.0	100.7	72.2	62.8	72.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1.3	15.5								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	440		
Part	0		
ExFlr	45		
Roof	0	0	0
Wall	567	32	6

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-12.0	209	72.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-2.6	600	68.0	72.0
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-14.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	98	98
Supply	600	209
Mincfm	600	0
Return	600	209
Exhaust	98	0
Rm Exh	98	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.36
Clg Cfm/Ton	464.52
Clg Sqft/Ton	340.65
Clg Btuh/Sqft	35.23
No. People	8
Htg % OA	0.0
Htg Cfm/SqFt	0.48
Htg Btuh/SqFt	-33.22

TEMPERATURES (F)

Type	Clg	Htg
SADB	72.5	125.0
Plenum	79.4	63.3
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.1	0.0
Fn Frict	0.4	0.0

System 11 Peak SZ - SINGLE ZONE

************************* COOLING COIL PEAK ********************************* CLG SPACE PEAK ************* HEATING COIL PEAK ********

						*			*			
Peaked at Time ==>		Mo/Hr: 7/15				*	Mo/Hr: 7/16		*	Mo/Hr: 13/ 1		
Outside Air ==>		OADB/WB/HR: 96/ 77/112.0				*	OADB: 96		*	OADB: 3		
	Space Sens.+Lat.	Ret. Air Sensible	Ret. Air Latent	Net Total	Percnt Of Tot	*	Space Sensible	Percnt Of Tot	*	Space Sensible	Total Sensible	Percnt Of Tot
Envelope Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	C	0	0.00
Roof Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Solar	24,134	0		24,134	18.97	*	25,382	28.06	*	0	0	0.00
Glass Cond	3,883	0		3,883	3.05	*	3,858	4.26	*	-16,981	-16,981	10.82
Wall Cond	18,061	2,420		20,482	16.10	*	18,310	20.24	*	-53,853	-66,849	42.59
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	47,186			47,186	37.08	*	19,685	21.76	*	-73,115	-73,115	46.59
Sub Total==>	93,265	2,420		95,685	75.19	*	67,235	74.33	*	-143,948	-156,944	100.00
Internal Loads						*			*			
Lights	19,298	12,866		32,164	25.28	*	19,298	21.33	*	0	0	0.00
People	8,919			8,919	7.01	*	4,655	5.15	*	0	0	0.00
Misc	20,547	0	0	20,547	16.15	*	20,792	22.98	*	0	0	0.00
Sub Total==>	48,765	12,866	0	61,631	48.43	*	44,745	49.46	*	0	0	0.00
Ceiling Load	15,286	-15,286		0	0.00	*	15,346	16.96	*	-12,996	0	0.00
Outside Air	0	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sup. Fan Heat				6,020	4.73	*		0.00	*		0	0.00
Ret. Fan Heat		783		783	0.61	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	-36,866			-36,866	-28.97	*	-36,866	-40.75	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	120,449	783	0	127,252	100.00	*	90,460	100.00	*	-156,944	-156,944	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	13.7	164.1	132.8	4,910	78.0	64.9	73.9	60.1	53.8	53.6
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	13.7	164.1								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	4,188		
Part	0		
ExFlr	0		
Roof	0	0	0
Wall	3,521	416	12

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-156.9	2,541	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	4,910	68.0	59.9
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-156.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	1,038	1,038
Supply	4,910	2,541
Mincfm	4,910	0
Return	4,910	2,541
Exhaust	4,910	0
Rm Exh	1,037	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.17
Clg Cfm/Ton	359.01
Clg Sqft/Ton	306.22
Clg Btuh/Sqft	39.19
No. People	23
Htg % OA	0.0
Htg Cfm/SqFt	0.61
Htg Btuh/SqFt	-37.47

TEMPERATURES (F)

Type	Clg	Htg
SADB	61.0	125.0
Plenum	89.5	58.2
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

System 12 Peak SZ - SINGLE ZONE

************************* COOLING COIL PEAK ******************************** CLG SPACE PEAK ************ HEATING COIL PEAK ********

	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Total Sensible (Btuh)	Percnt Of Tot (%)
Peaked at Time ==>	Mo/Hr: 7/15					Mo/Hr: 7/16		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 77/112.0					OADB: 96		OADB: 3		
Envelope Loads										
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	C	0	0.00
Roof Cond	17,656	0		17,656	10.74	17,387	15.68	-17,495	-17,495	0.00
Glass Solar	24,192	0		24,192	14.72	25,443	22.94	0	0	0.00
Glass Cond	3,893	0		3,893	2.37	3,867	3.49	-17,021	-17,021	9.41
Wall Cond	21,053	0		21,053	12.81	21,342	19.25	-62,772	-62,772	34.70
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	53,959			53,959	32.82	22,510	20.30	-83,610	-83,610	46.22
Sub Total==>	120,753	0		120,753	73.46	90,551	81.66	-180,898	-180,898	100.00
Internal Loads										
Lights	24,382	9,753		34,135	20.77	24,382	21.99	0	0	0.00
People	11,634			11,634	7.08	6,072	5.48	0	0	0.00
Misc	17,309	0	0	17,309	10.53	17,506	15.79	0	0	0.00
Sub Total==>	53,325	9,753	0	63,078	38.37	47,960	43.25	0	0	0.00
Ceiling Load	0	0		0	0.00	0	0.00	0	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				7,234	4.40		0.00		0	0.00
Ret. Fan Heat		940		940	0.57		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	-27,619			-27,619	-16.80	-27,619	-24.91	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	146,460	10,693	0	164,387	100.00	110,892	100.00	-180,898	-180,898	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering Deg F	Entering Grains	Leaving DB/WB/HR Deg F	Leaving Deg F	Leaving Grains
Main Clg	16.0	192.0	155.5	5,900	78.0	64.9	73.9	59.7	54.1	55.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	16.0	192.0								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	4,188		
Part	0		
ExFlr	0		
Roof	5,176	0	0
Wall	3,236	417	13

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-180.9	2,929	68.0	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	5,900	68.0	59.5
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-180.9			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	1,187	1,187
Supply	5,900	2,929
Mincfm	5,900	0
Return	5,900	2,929
Exhaust	5,900	0
Rm Exh	1,183	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	1.41
Clg Cfm/Ton	368.74
Clg Sqft/Ton	261.74
Clg Btuh/Sqft	45.85
No. People	30
Htg % OA	0.0
Htg Cfm/SqFt	0.70
Htg Btuh/SqFt	-43.19

TEMPERATURES (F)

Type	Clg	Htg
SADB	60.7	125.0
Plenum	78.0	68.0
Return	78.0	68.0
Ret/OA	78.0	68.0
Runarnd	78.0	68.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2
BASE LOAD

MONTHLY ENERGY CONSUMPTION

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	STEAM (Therm)
Jan	10,633	53	611
Feb	9,547	54	532
March	10,846	54	374
April	8,658	54	6
May	10,038	54	0
June	17,624	91	0
July	20,992	99	0
Aug	19,393	92	0
Sept	12,050	84	0
Oct	9,581	54	0
Nov	8,926	53	70
Dec	9,962	54	814
Total	148,250	99	2,407

Building Energy Consumption = 58,199 (Btu/Sq Ft/Year) Floor Area = 12,830 (Sq Ft)
Source Energy Consumption = 143,339 (Btu/Sq Ft/Year)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
BASE LOAD

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	5281	4672	5554	4987	5554	5260	5007	5828	4713	5281	4987	4733	61,857
	PK	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3
1	MISC LD													
	ELEC	2947	2601	3121	2774	3121	3260	3069	3644	2877	2947	2774	2601	35,736
	PK	16.7	16.7	16.7	16.7	16.7	18.9	18.9	18.9	18.9	16.7	16.7	16.7	18.9
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1121S		AC RECIP CHILLER 20-60 T											
	ELEC	0	0	0	0	0	5342	7352	5435	2105	0	0	0	20,233
	PK	0.0	0.0	0.0	0.0	0.0	28.1	32.1	27.0	20.7	0.0	0.0	0.0	32.1
1	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	0	645	967	671	244	0	0	0	2,528
	PK	0.0	0.0	0.0	0.0	0.0	3.6	4.7	3.4	2.8	0.0	0.0	0.0	4.7
1	EQ5001		CHILLED WATER PUMP C.V.											
	ELEC	0	0	0	0	0	984	1017	1017	594	0	0	0	3,612
	PK	0.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	3.0
1	EQ5313		CONTROLS											
	ELEC	0	0	0	0	0	99	102	102	60	0	0	0	363
	PK	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.3
2	EQ1170S		AC COND COMP <20 TONS											
	ELEC	0	0	0	0	0	0	439	195	33	0	0	0	668
	PK	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	1.3	0.0	0.0	0.0	1.6
2	EQ5200		CONDENSER FANS											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
BASE LOAD

	ELEC	0	0	0	0	0	0	58	24	4	0	0	0	86
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.2
2	EQ5313		CONTROLS											
	ELEC	0	0	0	0	0	0	102	86	21	0	0	0	209
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.3
1	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	20	18	18	13	15	28	35	35	21	17	13	13	246
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	0	1	15	13	15	24	18	18	13	14	13	12	157
	PK	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	12	33	39	35	39	69	48	48	35	37	35	33	462
	PK	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	0	0	15	13	15	25	17	18	13	14	13	12	154
	PK	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	4	3	4	2	3	10	19	18	10	4	2	4	83
	PK	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
6	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	4	3	4	3	15	23	19	18	13	14	13	10	140
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	14	12	15	13	15	15	16	17	13	14	13	12	169
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
8	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	0	7	10	9	10	17	11	12	9	9	9	8	110
	PK	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
9	EQ4003		FC CENTRIF. FAN C.V.											
	ELEC	95	85	87	36	26	26	364	189	55	28	31	108	1,130
	PK	0.5	0.5	0.5	0.5	0.5	0.5	1.2	1.2	1.2	0.5	0.5	0.5	1.2
10	EQ4371		FAN COIL SUPPLY FAN											
	ELEC	11	10	10	4	3	3	10	28	6	3	3	11	102
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2
11	EQ4003		FC CENTRIF. FAN C.V.											
	ELEC	503	448	456	300	579	878	1094	959	573	546	303	533	7,172
	PK	1.9	1.9	1.9	1.9	3.6	3.6	3.6	3.6	3.6	3.6	1.9	1.9	3.6
12	EQ4003		FC CENTRIF. FAN C.V.											
	ELEC	590	527	552	346	630	916	1226	1030	637	652	402	624	8,133
	PK	2.2	2.2	2.2	2.2	4.4	4.4	4.4	4.4	4.4	4.4	2.2	2.2	4.4
1	CONVERTR		STEAM TO HOT WATER CONVERTER											

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
BASE LOAD

	P STEAM	611	532	374	6	0	0	0	0	0	0	70	814	2,407
	PK	4.4	4.4	4.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	4.4	4.4
1	EQ5020		HEAT WATER CIRC. PUMP C.V.											
	ELEC	940	919	773	89	0	0	0	0	0	0	257	1017	3,994
	PK	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0
1	EQ5060		CONDENSATE RETURN PUMP											
	ELEC	213	208	175	20	0	0	0	0	0	0	58	231	906
	PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7

UTILITY PEAK CHECKSUMS - ALTERNATIVE 2
BASE LOAD

U T I L I T Y   P E A K   C H E C K S U M S

Utility ELECTRIC DEMAND

Peak Value 99.2 (kW)
Yearly Time of Peak 15 (hr) 7 (mo)

Hour 15 Month 7

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
Cooling Equipment				
1	EQ1121S	AC RECIP CHILLER 20-60 T	40.0	40.36
2	EQ1170S	AC COND COMP <20 TONS	2.1	2.08
Sub Total			42.1	42.44
Sub Total			0.0	******
Air Moving Equipment				
1		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.11
2		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.08
3		SUMMATION OF FAN ELECTRICAL DEMAND	0.2	0.22
4		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.08
5		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.08
6		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.08
7		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.08
8		SUMMATION OF FAN ELECTRICAL DEMAND	0.1	0.05
9		SUMMATION OF FAN ELECTRICAL DEMAND	1.2	1.19
11		SUMMATION OF FAN ELECTRICAL DEMAND	3.6	3.65
12		SUMMATION OF FAN ELECTRICAL DEMAND	4.4	4.39
Sub Total			9.9	10.03
Sub Total			0.0	0.00
Miscellaneous				
Lights			28.3	28.50
Base Utilities			0.0	0.00
Misc Equipment			18.9	19.04
Sub Total			47.1	47.53
Grand Total			99.2	100.00

CALIFORNIA TITLE 24 COMPLIANCE - ALTERNATIVE 2
BASE LOAD

CALIFORNIA TITLE 24 COMPLIANCE REPORT

Weather Name .... FTLVNWTH
Gross Conditioned Floor Area (sqft)...... 12,830
ACM Multiplier 1.008

ENERGY USE SUMMARY

	ELEC (kWh/yr)	DISTRICT STEAM (kBtu/yr)	PERCENT OF TOTAL ENERGY (%)	TOTAL SOURCE ENERGY (kBtu/yr)	ADJUSTED UNIT SOURCE ENERGY (kBtu/yr-sf)
Primary Heating	906.1	240,718.4	32.7	330,236.8	25.9
Primary Cooling					
Compressor	20,900.9	0.0	9.6	214,025.3	16.8
Tower/Cond Fans	2,614.5	0.0	1.2	26,772.2	2.1
Condenser Pump	0.0	0.0	0.0	0.0	0.0
Other Accessories	572.4	0.0	0.3	5,861.4	0.5
Auxiliary					
Supply Fans	18,057.3	0.0	8.3	184,907.0	14.5
Circulation Pumps	7,606.2	0.0	3.5	77,887.2	6.1
Base Utilities	0.0	0.0	0.0	0.0	0.0
Subtotal	25,663.4	0.0	11.7	262,794.2	20.6
Lighting	61,856.7	0.0	28.3	633,414.1	49.8
Receptacle	35,735.9	0.0	16.3	365,936.9	28.8
Domestic Hot Water	0.0	0.0	0.0	0.0	0.0
Cogeneration	0.0	0.0	0.0	0.0	0.0
Totals	148,250.0	240,718.4	100.0	1,839,041.0	144.5

ECO-M3

SERVICE STEAM PIPING AND TRAPS

STEAM PIPING AND TRAPS
ENERGY CONSERVATION OPPORTUNITY: ECO-M3

PURPOSE:

The purpose of this Energy Conservation Opportunity (ECO-M3) is to calculate the savings realized by servicing the steam piping and the steam traps. Steam traps are designed to hold steam in the heating device until it gives up its latent heat, and to separate condensate from the steam supply. The steam trap then allows the liquid condensate to discharge and return to the boilers where it is reheated into steam.

Steam traps are mechanical devices that wear with time, and eventually fail. Steam trap failure can occur in the open position, or in the closed position. When a trap fails in the closed position it is usually noticed and repaired quickly. This is because condensate backs up into the heating device, reducing the efficiency of the heat transfer surface, and the heating device can no longer function properly.

More commonly, steam traps fail in the open position, and trap failure is not as readily apparent. An open steam trap needlessly wastes energy by allowing steam to escape through a vent line to the atmosphere, or by condensing in the condensate piping. Condensate piping is normally installed in chases, tunnels, mechanical rooms or other unconditioned spaces. When condensate is allowed to give up its latent heat to these areas, it translates into increased energy costs.

Steam traps must also vent air from the piping system to the atmosphere to prevent the corrosive effects of oxygen on the pipe, which will eventually lead to the premature failure of the piping system.

Steam trap, and steam piping maintenance and repair are vital to the control of energy usage. The frequency of steam trap inspection depends on the steam supply pressure, and the type of trap. Steam traps operating at pressures between 30 psig and 120 psig, should be inspected monthly. Steam traps operating at pressures below 30 psig should be inspected on a semi-annual basis. When faulty steam traps are discovered they should be repaired, or replaced with a new steam trap.

There are three methods available for the inspection of steam traps as follows:

1) Temperature Testing.

2) Sonic Testing.

3) Manual Inspection.

Due to the cost of the temperature and sonic testing equipment, the specialized training required for their operation, and the changing maintenance personnel at the USDB, the first two methods are not advisable "in house". Temperature and sonic testing can be performed reliable by a trap testing service. Manual inspection involves

the installation of a test valve downstream from each steam trap, to observe the steam and condensate as they escape the test valve.

The following is a guideline of what to look for when manually testing steam traps:

Condensate Discharge

1) Intermittent condensate discharge from disc traps indicates normal operation.

2) Thermostatic traps can have a continuous discharge under heavy load, or an intermittent discharge of condensate under light load.

3) The inverted bucket trap can also have a continuous, or intermittent discharge of condensate depending upon the load. When an inverted bucket trap operates under a **very** small load, it can have a continuous condensate discharge, and will display a "dribbling effect".

Flash Steam

Condensate under pressure is able to hold more heat (BTU's) per pound than condensate at atmospheric pressure. When the condensate is discharged from the steam trap, this extra heat is re-evaporated into steam (flash steam).

1) Flash steam should not be mistaken for steam leakage through the steam trap.

2) Flash steam "floats" out intermittently (each time condensate discharges) as a "whitish cloud".

3) A leaking steam trap, manifests a continuous "blue" stream blowing out of the steam trap.

SCOPE:

Steam is delivered to the various buildings by a system of insulated high pressure steam pipes located in tunnels. Condensate is returned through piping located in the same system of tunnels by gravity to the boilers located in the boiler plant.

MODELING TECHNIQUES:

Table M3-1 below indicates the amount of steam lost through various steam traps when the trap has failed. These losses are based on total steam trap failure.

TABLE M3-1

Type of Steam Trap	Condensate Capacity Lbs./Hr.	Steam Loss Lbs./Hr.
Disc	300-900	55-170
Float & Thermostatic	350-650	65-170
Thermostatic	600-1900	110-350
Inverted Bucket:		
With 5/16" orifice	350	35
With restricted orifice	350	35

A steam trap can fail in the wide open position, but it will not waste live steam 24 hours a day, 365 days a year. The trap will still handle the condensate load for which it was selected, and will also only pass live steam when the steam to the device is turned on, and then somewhat proportional to the degree of opening of the control valve.

Energy lost through leaking steam traps must be adjusted for seasonal usage. The following two examples are given for 350 lbs./hr. capacity steam traps.

EXAMPLE #1

A bucket trap serving a steam main that is operational for the entire year would waste:

35 lbs./hr. X 8760 hrs./yr. X $5.75/1000 lbs. of steam) = $1763 a year.

EXAMPLE #2

A float and thermostatic trap serving a heating coil operating only during the heating months would lose:

65 lbs./hr. X 4380 hrs./yr. X 0.5 (system modulation factor) X ($5.75/1000 lbs. of steam) = $819 a year.

ECO IMPLEMENTATION:

The figures above demonstrate the economic loss that can be experienced because of steam trap failure. If only ten steam traps within a facility failed, the cost for the wasted steam could be $10,000 per year.

Calculation Sheet M3-1 shows the cost of installing test valves on steam traps, and the money saved assuming a 10% failure rate, and the cost of inspecting the traps.

Calculation Sheet M3-2 shows the cost of having an outside service inspection performed on the steam traps. The prices were obtained from Hughes Machinery Company, the local representative of Armstrong steam traps. The life cycle cost analysis summary sheet indicates the cost of inspection, and dollar savings from replacing traps based on a 100 trap system.

SUMMARY:

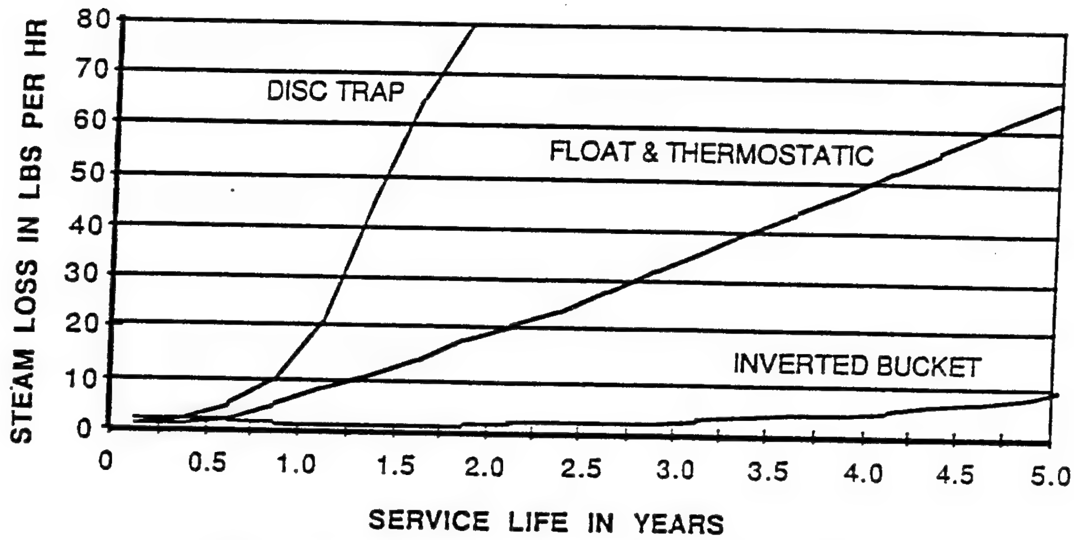
The life cycle cost summary sheet indicates the cost to install the trap testing valves, the cost of inspection, and the dollar savings from replacing the steam traps based on a 100 trap system.

A construction cost of $15,738 for in-house steam trap testing gives a 4.55 savings to investment ratio, and a 2.56 year simple payback.

An outside testing service is recommended at a cost of $16,150. The payback and SIR are essentially the same as in-house testing.

The graph of steam trap comparison is published by Armstrong Machine Works.

TRAP COMPARISON - STEAM LOSS VS SERVICE LIFE



Steam losses over the service life of traps, Test conditions were 150 psig steam inlet pressure, 0 psig outlet pressure

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 1 OF 1
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	____X____ CODE A (NO DESIGN COMPLETED) ________ CODE B (PRELIMINARY DESIGN) ________ CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.	ESTIMATOR: TGD	CHECKED BY

	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
INSTALL TEST VALVE (PER TRAP)							
CREW 1 STEAM FITTER, 1 APPRENTICE							
DISCONNECT EXISTING PIPE	1.00	MH	$22.27	$22	$20.00	$20	$42
INSTALL TEE AND TEST LINE	0.75	MH	$22.27	$17	$5.40	$4	$21
INSTALL GLOBE VALVE	0.75	MH	$22.27	$17	$17.10	$13	$30
SUBTOTAL				$56		$37	$93
CONTINGENCY 10%			10%	$6	10%	$4	$10
SUBTOTAL				$62		$41	$103
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$2	13.0%	$5	$7
DIRECT COST				$64		$46	$110
OVERHEAD AND PROFIT			25%	$16	25%	$11	$27
SUBTOTAL				$80		$57	$137
CONSTRUCTION COST PER TRAP							$137

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CALCULATION SHEET	DATE March,1987	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE STEAM TRAP PROGRAM - OWNER TESTING	COMPUTED BY TGD	CHECKED BY

COST OF STEAM AT FORT LEAVENWORTH - USDB

ENTHALPY OF WATER AT 160° F. = 128 BTU/LBM
ENTHALPY OF STEAM AT 120 PSIG = 1,192 BTU/LBM
STEAM EFFICIENCY = 74%

NATURAL GAS COST = $4.00 MCF
HEAT CONTENT OF NAT. GAS = 1,000,000 BTU/MCF

((1192-128)*$4.00)/0.74*1,000) $5.75 PER THOUSAND LB STEAM

COST OF INSPECTING TRAPS AFTER TEST VALVES ARE INSTALLED.

ASSUMING AN AVERAGE OF 50 TRAPS PER DAY 8 HOURS PER DAY.

8 MH	X	$36.75 PER HOUR =	$294 PER DAY
$294	/	50 TRAPS PER DAY =	$5.88 PER TRAP

COST OF INSTALLING TEST VALVES ON EACH TRAP = $137

SAVINGS FROM TRAP INSPECTION

USING 100 TRAPS AS A BASE WITH A 10% FAILURE RATE; 350 LB/HR F&T TRAP

COST OF INSPECTING TRAPS ONCE DURING THE HEATING SEASON	100 X $5.88	= $588/YEAR
NUMBER OF TRAPS FAILED	100 X 10%	= 10 TRAPS
COST OF REPAIRING TRAPS	10 X $145	= $1,450/YEAR
TOTAL COST OF INSPECTING AND REPAIRING TRAPS		= $2,038 /YEAR
65 lbs/hr x 4380 hrs/yr x 0.5 (sys. modulation factor) =		142,350 LBS OF STM/YEAR/TRAP
# of steam x (1192-128)/1,000,000		= 151 MBTU/YEAR/TRAP
@ $5.75/1000 # steam		= $868/YEAR/PER TRAP
ENERGY LOST DUE TO FAILED TRAPS	10 X 151 =	1510 MBTU/YEAR
COST OF STEAM LOST DUE TO FAILED TRAPS	10 X $868 =	$8,680/YEAR
INITIAL INVESTMENT FOR TEST VALVES	100 X $137 =	$13,700

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM3
ANALYSIS DATE: 03-23-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	15738.
B. SIOH	$	944.
C. DESIGN COST	$	866.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	15793.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	15793.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	1510.	$ 6161.	11.67	71899.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		1510.	$ 6161.		$ 71899.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 23727.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 6161.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 71899.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 4.55
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.56

CALCULATION SHEET	DATE March,1987	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE STEAM TRAP PROGRAM - OWNER TESTING	COMPUTED BY TGD	CHECKED BY

COST OF STEAM AT FORT LEAVENWORTH - USDB

ENTHALPY OF WATER AT 160° F. = 128 BTU/LBM
ENTHALPY OF STEAM AT 120 PSIG = 1,192 BTU/LBM
STEAM EFFICIENCY = 74%

NATURAL GAS COST = $4.00 MCF
HEAT CONTENT OF NAT. GAS = 1,000,000 BTU/MCF

((1192-128)*$4.00)/0.74*1,000) $5.75 PER THOUSAND LB STEAM

COST OF INSPECTING TRAPS USING AN OUTSIDE TESTING SERVICE.

ASSUMING AN AVERAGE OF 50 TRAPS PER DAY, 8 HOURS PER DAY.
THE COST IS A FLAT FEE OF $500 PER DAY.

$500/50 TRAPS = $10 PER TRAP

COST OF INSTALLING TEST VALVES ON EACH TRAP = $137

SAVINGS FROM TRAP INSPECTION

USING 100 TRAPS AS A BASE WITH A 10% FAILURE RATE; 350 LB/HR F&T TRAP

COST OF INSPECTING TRAPS ONCE DURING THE HEATING SEASON	100 X $10	= $1,000/YEAR
NUMBER OF TRAPS FAILED	100 X 10%	= 10 TRAPS
COST OF REPAIRING TRAPS	10 X $145	= $1,450/YEAR
TOTAL COST OF TESTING AND REPAIRING TRAPS		= $2,450 /YEAR
65 lbs/hr x 4380 hrs/yr x 0.5 (sys. modulation factor) =		142,350 LBS OF STM/YEAR/TRAP
# of steam x (1192-128)/1,000,000		= 151 MBTU/YEAR/TRAP
@ $5.75/1000 # steam		= $868/YEAR/PER TRAP
ENERGY LOST DUE TO FAILED TRAPS	10 X 151 =	1510 MBTU/YEAR
COST OF STEAM LOST DUE TO FAILED TRAPS	10 X $868 =	$8,680/YEAR
INITIAL INVESTMENT FOR TEST VALVES	100 X $137 =	$13,700

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM3
ANALYSIS DATE: 03-23-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	16150.
B. SIOH	$	969.
C. DESIGN COST	$	888.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	16206.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	16206.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	1510.	$ 6161.	11.67	71899.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		1510.	$ 6161.		$ 71899.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 23727.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 6161.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 71899.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 4.44
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.63

ECO-M5

EXHAUST HEAT RECOVERY

EXHAUST HEAT RECOVERY

ENERGY CONSERVATION OPPORTUNITY: ECO-M5

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M5) analyzes the energy savings associated with the installation of heat recovery units to preheat outside air. Energy savings can be accomplished by using exhaust air to preheat outside air used for ventilation. Heat recovery coils can be used to transfer heat energy from the exhaust air to the ventilation air stream.

SCOPE:

The ECO simulation (ECO-M5) includes the installation of heat recovery units in the exhaust air stream and the outside air intake air stream. The application of this ECO was considered for the following buildings.

Building	475C	Building 475D
Building	475G	Building 475F

Heat recovery units were also considered for reclaiming heat from steam tunnel vents but there was not a viable use for the heat energy. None of the other buildings in the USDB have a substantial amount of exhaust air which could be used for heat recovery.

MODELING TECHNIQUES:

The total energy savings associated with ECO-M5 was calculated using computer models of Q-Dot air to air units, Z-Duct air to air heat pipe units and Run Around Coil Loop heat recovery units. The Q-Dot unit had the best payback because of it's low maintenance and high energy savings. The Run Around Coil Loop system has a high efficiency but it's high operation and maintenance costs reduce it's energy savings. The Z-Duct system, like the Q-Dot units are somewhat maintenance free, but for this application the Q-Dot unit was more efficient. The installed cost estimates for all the systems were done using manufacture quotes along with Means Mechanical Cost Data. Table M5-1 compares all three heat recovery systems on a one building bases.

ECO IMPLEMENTATION:

The implementation of this ECO will include the installation of heat recovery units in buildings 475C, 475D, 475G, and 475F. The energy savings in BTU's per year were taken directly from the computer models and were converted manually into a dollar per year value. A difficulty factor of 2 was added to the installation cost of each unit because of the height at which the systems are to be installed. The repair and maintenance of the rest of the air handling equipment in these buildings are not included in this project but must be done before this ECO is valid.

SUMMARY:

This project cost is the construction cost is 6% SIOH.

The energy savings associated with the implementation of this ECO by building is shown below in Table M5-1. A MBTU's per year savings as determined using the computer simulation model.

Doesn't Agree!

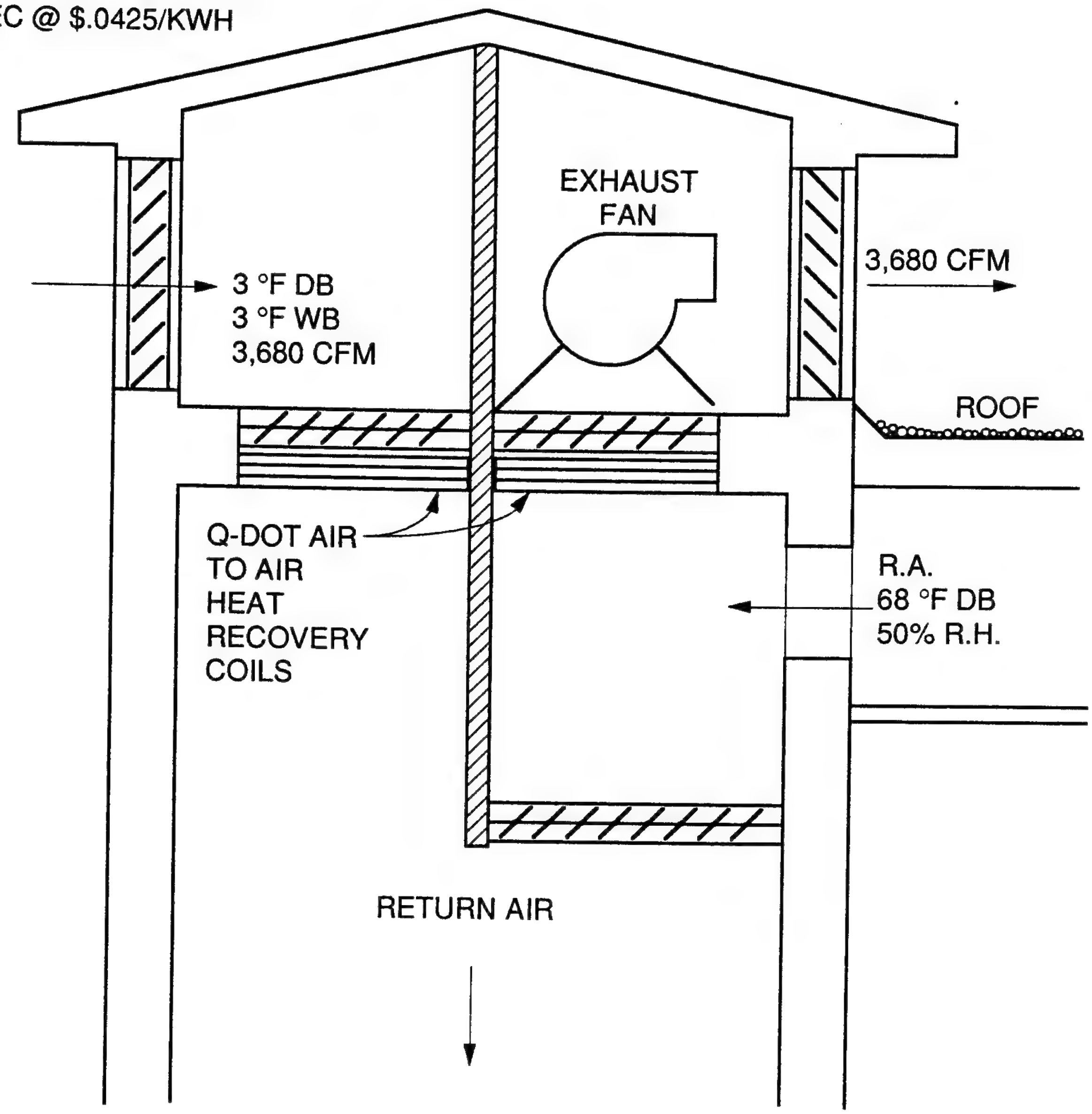
System Type	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
Q-Dot	453.2	$2,130	$12,908	6.66	1.76
Z-Duct	293.7	$1,568	$13,563	10.81	1.08
Coil Loop	300.9	$953	$16,273	12.81	0.92

Table M5-1

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION	FORT LEAVENWORTH, KANSAS		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M5: HEAT RECOVERY	COMPUTED BY RGB	CHECKED BY MAW

OPERATED: 24 HR./DAY, NOVEMBER THROUGH MARCH

STEAM @ $.53/THERM
ELEC @ $.0425/KWH



Q-DOT HEAT RECOVERY SYSTEM TYPICAL SECTION BUILD

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM5Q
ANALYSIS DATE: 03-19-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	12178.
B. SIOH	$	731.
C. DESIGN COST	$	670.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	12221.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	12221.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	1.	$ 12.	8.69	104.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	453.	$ 1848.	11.67	21566.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		454.	$ 1860.		$ 21670.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 7151.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1860.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 21670.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.77
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.57

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM5Z
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	12795.
B. SIOH	$	768.
C. DESIGN COST	$	704.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	12840.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	12840.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	-1.	$ -12.	8.69	-104.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	294.	$ 1200.	11.67	14004.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		293.	$ 1188.		$ 13900.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4587.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1188.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 13900.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.08
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 10.81

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM5CL
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	15352.
B. SIOH	$	921.
C. DESIGN COST	$	844.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	15405.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	15405.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	-2.	$ -25.	8.69	-217.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	301.	$ 1228.	11.67	14331.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		299.	$ 1203.		$ 14114.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4658.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1203.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 14114.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.92
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 12.81

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF 1

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
ECO-M5	RGB	MAW

Q-Dot Air to Air Heat Recovery System	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Q-Dot Air to Air Units	1	EA	$3,467	$3,467	$2,000	$2,000	$5,467
MISC. CONTROLS	1	EA	$400	$400	$100	$100	$500
SEALED SHEET METAL BLOCK OFF	63	SQ. FT	$2	$126	$12	$756	$882
PROP. FAN W/ SHEET METAL HOUSING	1	EA	$900	$900	$500	$500	$1,400
SUBTOTAL				$4,893		$3,356	$8,249
CONTINGENCY 10%			10%	$489	10%	$336	$825
SUBTOTAL				$5,382		$3,692	$9,074
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$188	13.0%	$480	$668
DIRECT COST				$5,570		$4,172	$9,742
OVERHEAD AND PROFIT			25%	$1,393	25%	$1,043	$2,436
SUBTOTAL				$6,963		$5,215	$12,178
CONSTRUCTION COST							$12,178

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF 1

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE __X__ CODE A (NO DESIGN COMPLETED) ____ CODE B (PRELIMINARY DESIGN) ____ CODE C (FINAL DESIGN) OTHER (SPECIFY)
LOCATION FORT LEAVENWORTH, KS	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	

DRAWING NO.	ESTIMATOR	CHECKED BY
ECO-M5	RGB	MAW

Z-Duct Air to Air Heat Recovery System	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Z-Duct Air to Air Units	1	EA	$3,900	$3,900	$2,000	$2,000	$5,900
MISC. CONTROLS	1	EA	$400	$400	$100	$100	$500
SEALED SHEET METAL BLOCK OFF	63	SQ. FT	$2	$126	$12	$756	$882
PROP. FAN W/ SHEET METAL HOUSING	1	EA	$900	$900	$500	$500	$1,400
SUBTOTAL				$5,326		$3,356	$8,682
CONTINGENCY 10%			10%	$533	10%	$336	$869
SUBTOTAL				$5,859		$3,692	$9,551
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$205	13.0%	$480	$685
DIRECT COST				$6,064		$4,172	$10,236
OVERHEAD AND PROFIT			25%	$1,516	25%	$1,043	$2,559
SUBTOTAL				$7,580		$5,215	$12,795
CONSTRUCTION COST							**$12,795**

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF 1

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	

DRAWING NO.	ESTIMATOR	CHECKED BY
ECO-M5	RGB	MAW

Exhaust Run Around Heat Recovery Loop	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
GLYCOL COILS	2	EA	$1,910	$3,820	$270	$540	$4,360
GLYCOL PUMP	1	EA	$370	$370	$132	$132	$502
PUMP SUPPORT	1	EA	$500	$500	$300	$300	$800
EXPANSION TANK	1	EA	$710	$710	$120	$120	$830
GLYCOL PIPE	25	LF	$4	$100	$8	$200	$300
PIPE INSULATION	25	LF	$2	$53	$2	$42	$94
TEES	2	EA	$3	$6	$24	$48	$54
ELLBOWS	4	EA	$2	$8	$15	$60	$68
BUTTERFLY VALVES	2	EA	$54	$108	$44	$88	$196
SUCTION DIFFUSER	1	EA	$152	$152	$55	$55	$207
THERMOMETER	3	EA	$6	$18	$19	$57	$75
TEMPERATURE TRANSMITTER	1	EA	$216	$216	$44	$44	$260
DIFF. PRESS. SWITCH W/ INDICATOR	1	EA	$403	$403	$28	$28	$431
PRESSURE GAUGES	3	EA	$12	$36	$6	$18	$54
SEALED SHEET METAL BLOCK OFF	63	SQ. FT	$2	$126	$12	$756	$882
PROP. FAN W/ SHEET METAL HOUSING	1	EA	$900	$900	$500	$500	$1,400
SUBTOTAL				$7,525		$2,988	$10,513
CONTINGENCY 10%			10%	$753	10%	$299	$1,052
SUBTOTAL				$8,278		$3,287	$11,565
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$290	13.0%	$427	$717
DIRECT COST				$8,568		$3,714	$12,282
OVERHEAD AND PROFIT			25%	$2,142	25%	$928	$3,070
SUBTOTAL				$10,710		$4,642	$15,352
CONSTRUCTION COST							$15,352

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

ECO-M6

INSULATE DUCTWORK

DUCTWORK INSULATION

ENERGY CONSERVATION OPPORTUNITY: ECO-M6

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M6) analyzes the energy savings associated with reducing the amount of heat transfer through the walls of the ductwork that carries air from the air handling equipment to the space being conditioned. The ductwork can lose or gain heat from the unconditioned spaces through which it is routed, thus not providing the required air temperature at the air outlet.

SCOPE:

The implementation of this ECO simulation (ECO-M6) would have to be to ductwork that exists that is routed in unconditioned spaces. The only buildings that contain central air handling equipment with ductwork to the space to be conditioned are:

Building 463	Building 475C
Building 465	Building 475D
Building 472	Building 475E
Building 473	Building 475F
Building 475	Building 475G

MODELING TECHNIQUE:

The modeling technique used to calculate the energy savings associated with insulating the ductwork located in unconditioned spaces, is a heat transfer calculation including the heat transfer coefficient of the ductwork walls and the temperature difference between the air inside and outside the ductwork. If the ductwork is located in conditioned spaces, then the addition of insulation to the ductwork will not effectively change the amount of energy used to condition the entire building because the temperature difference is zero. NOT TRUE.

SUMMARY:

The easiest method of insulating ductwork is on the outside of the metal. Another method is to insulate the ductwork on the inside of the metal. The insulation on the inside of the ductwork is typical when new ductwork is installed. To insulate the inside of existing ductwork is difficult and seldom feasible. All of the ductwork attached to air handling units, with the exception of the castle, is routed through conditioned spaces,

thus no energy savings is present. The ductwork for the air handling units located in the castle are concealed in the exterior walls of the structure. Because of changes in direction and transitions, insulating the inside of the ductwork is not feasible. The ductwork would have to be removed and re-installed with interior insulated ductwork, which is not cost effective. This ECO is not feasible under the present conditions.

ECO-M10

CENTRAL PLANT COOLING

CENTRAL CHILLER PLANT:

ENERGY CONSERVATION OPPORTNITY: ECO-M10

PURPOSE:

The purpose of this Energy Conservation Opportunity (ECO-M10) is to calculate the savings realized by installing a 400 ton centrifugal chiller to serve the air conditioning requirements for the USDB facility. The central chiller would replace the air cooled condensing units, and window mounted air conditioners that currently serve the buildings listed below.

SCOPE:

This project (ECO-M10) was considered for the following buildings:

Building	450
Building	463
Building	464
Building	465
Building	472
Building	473
Building	475A
Building	475B
Building	475H

MODELING TECHNIQUES:

The modeling technique used for ECO-M10 assumes that the existing equipment kilowatt per ton is 1.5 which is typical for air cooled condensers, and the central chiller plant kilowatt per ton is estimated at 0.95. The building energy use was calculated using the Trace Ultra energy simulation program.

ECO IMPLEMENTATION:

The removal of the existing air cooled condensing units, direct expansion cooling coils, the air cooled chiller serving the buildings at the south gate, and the window air conditioners is required to implement this ECO.

Installation of a centrifugal chiller, chilled water pump, condenser water pump, cooling tower, and accessories at building #474 is required for ECO-M10. The chilled water distribution piping will be installed in the existing piping tunnels.

SUMMARY:

The installation of a central chiller plant will save 64,330 kWh of electrical energy per year, and will cost $444,452 for the construction. A savings investment ratio of 0.05 disqualifies this project from consideration. The estimated simple payback is approximately 163 years.

CALCULATION SHEET	DATE Apr-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-M10	COMPUTED BY MJM	CHECKED BY MAW

THE CAPACITY OF COOLING PER BUILDING IS:

BUILDING	TONS CLG
450	32
463	22
464	26
465	17
472	69
473	39
475A	39
475B	28
475E	92
475H	20
TOTAL	384 TONS

INSTALL A 400 TON CENTRIFUGAL CHILLER IN THE BOILER PLANT

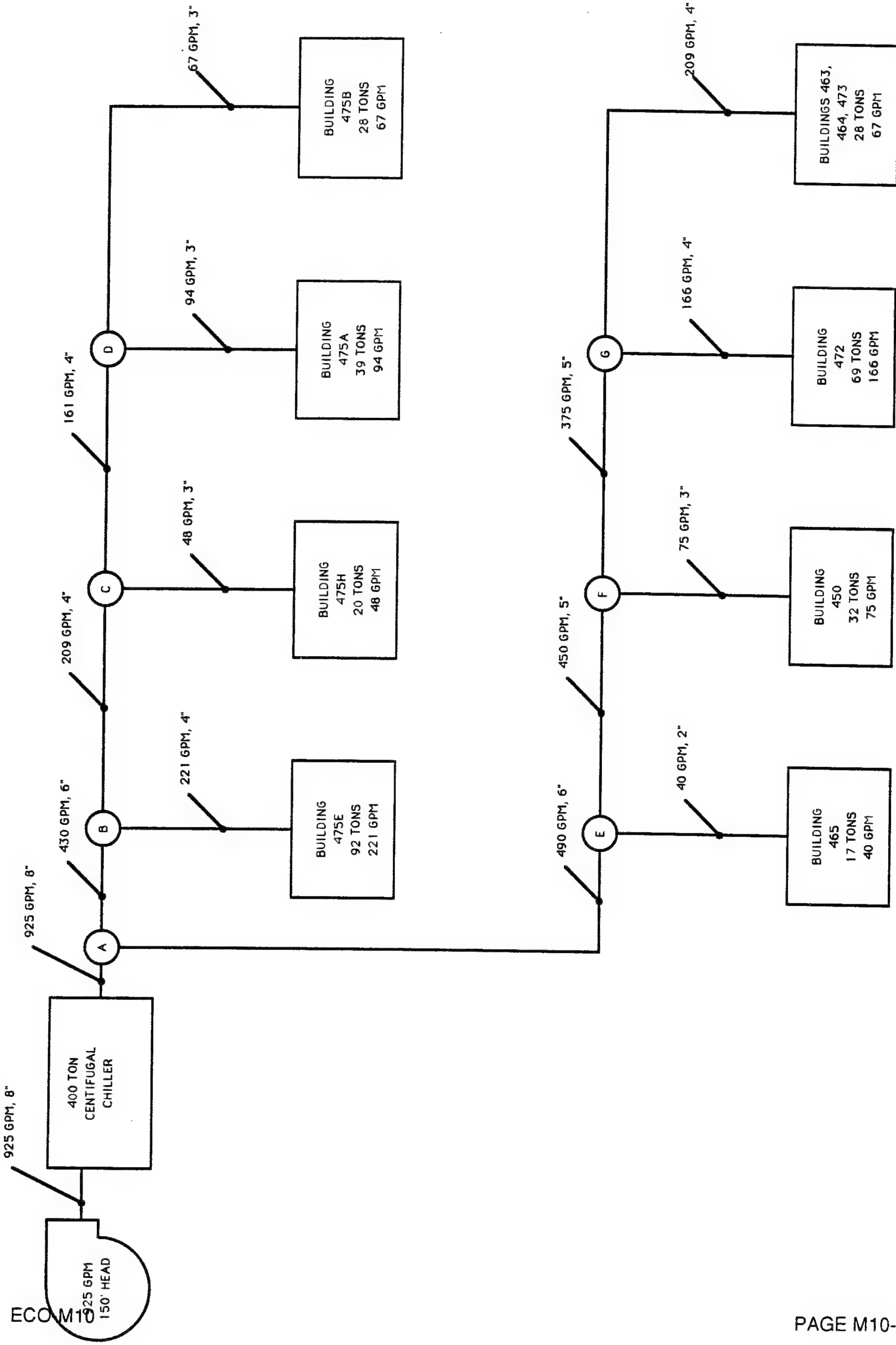
USING A TYPICAL DELTA TEMPERATURE OF 10°F

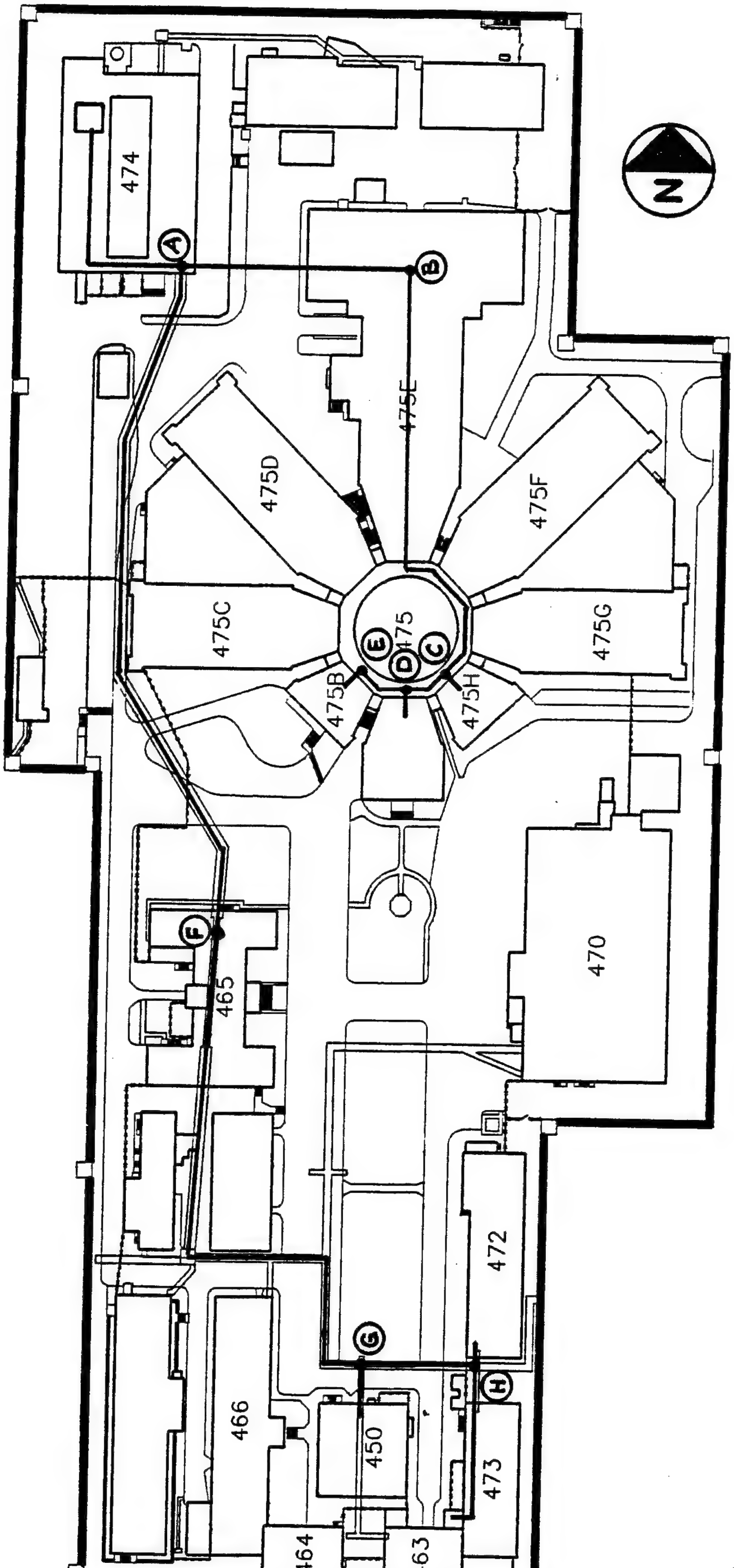
ENERGY = (GPM) (CP) (ΔT)
ENERGY = (384 TONS) (12,000 BTUH/TON) = 4,608,000 BTUH
CP = 1.O FOR WATER
ΔT = 10° F
GPM = (ENERGY) / (CP) (ΔT) (500 LB MIN / GAL HOUR)
GPM = 4,608,000 / 5000
GPM = 921.6

PUMP TO BE SIZED FOR 925 GPM

USING THE FOLLOWING SPREADSHEET, PIPE SIZES, NUMBER OF FITTINGS, AND FRICTION LOSS CAN BE DETERMINED.

THE PUMP WILL BE A 925 GPM, 150' HEAD END SUCTION.


925 GPM
150' HEAD
925 GPM, 8"
400 TON
CENTRIFUGAL
CHILLER
925 GPM, 8"
A
430 GPM, 6"
B
221 GPM, 4"
BUILDING
475E
92 TONS
221 GPM
209 GPM, 4"
C
48 GPM, 3"
BUILDING
475H
20 TONS
48 GPM
161 GPM, 4"
D
94 GPM, 3"
BUILDING
475A
39 TONS
94 GPM
67 GPM, 3"
BUILDING
475B
28 TONS
67 GPM
490 GPM, 6"
E
40 GPM, 2"
BUILDING
465
17 TONS
40 GPM
450 GPM, 5"
F
75 GPM, 3"
BUILDING
450
32 TONS
75 GPM
375 GPM, 5"
G
166 GPM, 4"
BUILDING
472
69 TONS
166 GPM
209 GPM, 4"
BUILDINGS 463,
464, 473
28 TONS
67 GPM


474
A
B
475E
475D
475F
475C
475
475G
E
D
C
475B
475H
F
465
470
472
G
H
466
450
473
464
463
N

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	BUILDING 474	X HAND	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP	___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ECO MEASURE	CENTRAL PLANT COOLING ECO-M10	COMPUTED BY TGD	CHECKED BY MAW

CHILLED WATER PUMP: 625 GPM @ 150 FT. HEAD

50 H.P. MOTOR - 1750 RPM - 480/60/3 - 65 F.L.A.

[(65 A.) (480 V.) ($\sqrt{3}$)] / 1,000 = 54 KW

CONDENSER WATER PUMP: 1200 GPM @ 75 FT. HEAD

30 H.P. MOTOR - 1750 RPM - 480/60/3 - 40 F.L.A.

[(40 A.) (480 V.) ($\sqrt{3}$)] / 1,000 = 33 KW

COOLING TOWER FAN: 20 H.P. MOTOR - 1750 RPM - 480/60/3 - 27 F.L.A.

[(27 A.) (480 V.) ($\sqrt{3}$)] / 1,000 = 22 KW

(0.9 POWER FACTOR) x (0.8 MOTOR EFFICIENCY) = 0.72 ELECTRICAL FACTOR

(39KW + 24KW + 16KW) x (0.72) = 78 KW FOR AUXILLARY EQUIPMENT

400 TON CHILLER: 0.75 KW / TON

78 KW / 400 TON = 0.20 KW / TON FOR AUXILLARY EQUIPMENT

0.75 + 0.20 = 0.95 KW / TON OVERALL EFFICIENCY FOR 400 TON CENTRIFUGAL CHILLER SYSTEM:

EXISTING COOLING EQUIPENT: 1.5 KW / TON

0.95 / 1.5 = 63% FUTURE ELECTRICAL ENERGY USEAGE WITH CENTRAL CHILLER PLANT:

PRESENT ENERGY USED FOR COOLING: 173,865 KWH

PROJECTED ENERGY USEAGE FOR COOLING: 109,535 KWH

ANNUAL ELECTRICAL SAVINGS: 64,330 KWH

ANNUAL ENERGY SAVINGS: 220 MBTU

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM10
ANALYSIS DATE: 03-19-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	444542.
B. SIOH	$	26673.
C. DESIGN COST	$	24450.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	446099.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	446099.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	220.	$ 2737.	8.69	23785.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		220.	$ 2737.		$ 23785.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 7849.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 2737.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 23785.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.05
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 162.99

CONSTRUCTION COST ESTIMATE			DATE PREPARED 4/2/90				SHEET 1 OF 2
PROJECT USDB ENERGY STUDY			BASIS FOR ESTIMATE				
LOCATION FORT LEAVENWORTH, KS			X CODE A (NO DESIGN COMPLETED)				
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)				
DRAWING NO. NONE		ESTIMATOR MJM			CHECKED BY MAW		

ECO-M10 CENTRAL PLANT COOLING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
400 TON CENTRIFUGAL CHILLER							
EXPANSION TANK AND TOWER	400	TON	260.13	$104,052	80.75	$32,300	$136,352
925 GPM PUMP, 150' HEAD	1	EA	1650.00	$1,650	390.00	$390	$2,040
8" BLACK STEEL PIPE, HANGERS, INSUL	160	FT	18.18	$2,909	22.17	$3,547	$6,456
6" BLACK STEEL PIPE, HANGERS, INSUL	1620	FT	12.20	$19,764	18.19	$29,468	$49,232
5" BLACK STEEL PIPE, HANGERS, INSUL	1400	FT	10.19	$14,266	13.86	$19,404	$33,670
4" BLACK STEEL PIPE, HANGERS, INSUL	1360	FT	7.45	$10,132	12.25	$16,660	$26,792
3" BLACK STEEL PIPE, HANGERS, INSUL	400	FT	5.32	$2,128	10.84	$4,336	$6,464
8" BLACK STEEL ELL	13	EA	66.00	$858	135.00	$1,755	$2,613
6" BLACK STEEL ELL	14	EA	37.00	$518	110.00	$1,540	$2,058
5" BLACK STEEL ELL	13	EA	37.00	$481	110.00	$1,430	$1,911
4" BLACK STEEL ELL	10	EA	14.90	$149	70.00	$700	$849
3" BLACK STEEL ELL	10	EA	9.00	$90	50.00	$500	$590
8" BLACK STEEL TEE	1	EA	91.00	$91	220.00	$220	$311
6" BLACK STEEL TEE	1	EA	50.00	$50	185.00	$185	$235
5" BLACK STEEL TEE	3	EA	50.00	$150	185.00	$555	$705
4" BLACK STEEL TEE	3	EA	27.00	$81	115.00	$345	$426
8" BUTTERFLY VALVE	4	EA	200.00	$800	120.00	$480	$1,280
6" BUTTERFLY VALVE	2	EA	140.00	$280	110.00	$220	$500
5" BUTTERFLY VALVE	2	EA	120.00	$240	110.00	$220	$460
4" BUTTERFLY VALVE	8	EA	86.00	$688	70.00	$560	$1,248
3" GATE VALVE	10	EA	105.00	$1,050	27.00	$270	$1,320

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M10	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 450 COOLING COIL REPLACEMENT	1	EA	1130.00	$1,130	435.00	$435	$1,565
BUILDING 450 REFRIGERATION DEMOLITION	2	TON			395.00	$790	$790
BUILDING 465 REFRIGERATION DEMOLITION	3	TON			395.00	$1,185	$1,185
BUILDING 472 COOLING COIL REPLACEMENT	1	EA	440.00	$440	88.00	$88	$528
BUILDING 472 REFRIGERATION DEMOLITION	2	TON			395.00	$790	$790
BUILDING 475A FAN COIL UNIT INSTALLATION	11746	SQ FT	0.74	$8,645	0.07	$865	$9,510
BUILDING 475B FAN COIL UNIT INSTALLATION	7400	SQ FT	0.74	$5,446	0.07	$545	$5,991
BUILDING 475H FAN COIL UNIT INSTALLATION	6744	SQ FT	0.74	$4,964	0.07	$496	$5,460
SUBTOTAL				$181,052		$120,279	$301,330
CONTINGENCY 10%			10%	$18,105	10%	$12,028	$30,133
SUBTOTAL				$199,157		$132,307	$331,463
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$6,970	13.0%	$17,200	$24,170
DIRECT COST				$206,127		$149,507	$355,633
OVERHEAD AND PROFIT			25%	$51,532	25%	$37,377	$88,909
SUBTOTAL				$257,659		$186,884	$444,542
CONSTRUCTION COST							$444,542

ENG. FORM 150
1AVC-59

ECO-M11

CASTLE AIR SYSTEM REPAIR

CASTLE AIR SYSTEM REPAIRS

ENERGY CONSERVATION OPPORTUNITY: ECO-M11

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M5) analyzes the energy savings associated with removal of air stratification in the castle domiciles. Stratification occurs in areas with high ceilings when hot air rises to the upper levels and there is no way for it to be circulated back down. Stratification in the castle domiciles is causing the upper levels to become over heated by an estimated 10°. An energy savings can be seen by repairing the return air systems which pulls the hot air from the upper levels and circulates it down through the lower levels. The implementation of this project will not change the number or capacity of any of the existing air handling systems.

SCOPE:

The ECO simulation (ECO-M11) includes the repair and maintenance of the existing air handling systems. The application of this ECO was considered for the following buildings.

Building	475C	Building 475D
Building	475G	Building 475F

The existing AHU's in these buildings are currently operating with no return air from the space. The doors of the fan room have been removed allowing the AHUs to pull in air from the pipe tunnels, chases or from wherever it finds the least amount of resistance. Replacing the doors and sealing off the fan rooms will allow the AHU's to pull warm return air from the top levels of these buildings. This will create proper air circulation and eliminate the air stratification. An energy savings will be seen by eliminating the over heating of the top levels of these buildings.

MODELING TECHNIQUES:

The energy savings associated with this ECO was calculated using a computer simulation developed as a base load on the facility. The existing HVAC systems were simulated to heat the top three tiers of each building to 10° above the 68° setpoint. The temperature was then set to 68° and the simulation was ran again to find the difference in energy use. The difference in the energy usage for these two computer runs is the energy savings for ECO-M11. The cost repairing these AHU's were done using Means Mechanical Cost Data.

ECO-M11 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION BASE ENERGY (THERMS)	ECO-M11 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	ELECTRIC CONSUMPTION BASE LOAD (KW)	ECO-M11 LOAD (KW)	ENERGY SAVINGS (MBTU)	TOTAL SAVINGS ($)
475C	13,472	10,745	273	45,478	45,427	0	$1,115
475D	15,188	12,422	277	53,358	53,317	0	$1,130
475F	15,926	12,856	307	53,357	53,324	0	$1,254
475G	12,853	10,380	247	45,481	45,427	0	$1,011
							$4,510

ECO IMPLEMENTATION:

The implementation of this ECO will include the installation of new doors on the fan rooms of each building. All pipe chases passing through the fan rooms will need to be sealed along with any other openings which presently exist. This will restore the return air system back to it's original design which will in turn eliminate any air stratification within these buildings.

SUMMARY:

The probable construction cost to implement this ECO by building is shown in Table M11-1. This project cost is the construction cost as determined in the appendix plus 6% SIOH.

The energy savings associated with the implementation of this ECO by building is shown below in Table M11-1 on a dollars per year savings as determined using the computer simulation model.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
475C	273	$1,458	$1,779	1.51	7.72
475D	277	$1,474	$1,779	1.49	7.83
475F	307	$1,641	$1,779	1.34	8.68
475G	247	$1,323	$1,779	1.67	6.99

Table M11-1

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM11C
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1678.
B. SIOH	$	101.
C. DESIGN COST	$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1684.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	273.	$ 1114.	11.67	13000.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		273.	$ 1114.		$ 13000.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4290.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1114.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 13000.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 7.72
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 1.51

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM11D
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1678.
B. SIOH	$	101.
C. DESIGN COST	$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1684.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	277.	$ 1130.	11.67	13187.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		277.	$ 1130.		$ 13187.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4352.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1130.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 13187.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 7.83
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 1.49

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM11F
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1678.
B. SIOH	$	101.
C. DESIGN COST	$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1684.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	307.	$ 1253.	11.67	14623.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		307.	$ 1253.		$ 14623.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 4826.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1253.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 14623.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 8.68
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 1.34

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM11G
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	1678.
B. SIOH	$	101.
C. DESIGN COST	$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1684.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	247.	$ 1008.	11.67	11763.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		247.	$ 1008.		$ 11763.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3882.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1008.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 11763.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 6.99
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 1.67

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 1 OF

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	__X__ **CODE A (NO DESIGN COMPLETED)**
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO. NONE	ESTIMATOR RGB	CHECKED BY **MAW**

ECO-M11	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
METAL DOORS	2	EA	$137	$274	$80	$160	$434
SHEET METAL ≈	50	SQ FT	$1	$63	$1	$70	$133
CAULKING MASONRY ≈	400	LF	$1	$224	$1	$336	$560
SUBTOTAL				$560		$566	$1,126
CONTINGENCY 10%			10%	$56	10%	$57	$113
SUBTOTAL				$616		$623	$1,239
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$22	13.0%	$81	$103
DIRECT COST				$638		$704	$1,342
OVERHEAD AND PROFIT			25%	$160	25%	$176	$336
SUBTOTAL				$798		$880	$1,678
CONSTRUCTION COST							**$1,678**

ENG. FORM 150
1AVC-59

ECO-M12

REDUCE STEAM DISTRIBUTION PRESSURE

REDUCE STEAM DISTRIBUTION PRESSURE
ENERGY CONSERVATION OPPORTUNITY: ECO-M12

PURPOSE:

The purpose of this Energy Conservation Opportunity (ECO-M12) is to calculate the savings realized by reducing the steam pressure for the USDB facility. The laundry requires 120 psig steam, while the space heating requirements can be served by 80 psig steam.

SCOPE:

Steam is delivered to the various buildings by a system of insulated high pressure steam pipes located in tunnels. The steam pressure at the boilers is maintained at 120 psig. The steam pressure is reduced at the individual buildings to the pressure required for space heating and/or any process usage.

Steam must be delivered at a pressure high enough to overcome the system resistance losses, while maintaining sufficient pressure to equal or exceed the downstream pressure requirement.

Reducing the steam pressure for energy savings will decrease the density of the steam in the steam piping. The steam will take up more volume in the pipes, making it a tighter squeeze to pass through the orifice plates used to measure steam flow.

Because the orifice plate sees a greater pressure drop for a given flow, the signal sent to the chart recorder will be greater also, and the chart will read proportionally higher. The orifice plates will have to be replaced for each steam recorder to reflect steam flow rates, accurately at a reduced steam pressure.

Steam trap capacities will also be reduced, due to the reduced differential pressure across the steam traps orifice. The traps affected will be the traps located in the Powerhouse, and the traps serving steam mains upstream of the pressure reducing valves.

Generally traps, and drip legs serving steam mains are oversized by the design engineer, and a reduction in steam pressure will not have an adverse effect the traps performance.

Nevertheless, lowering thesteam trap condensate handling capacity could cause water to back up into the the steam mains. This could possibly result in water hammer, if a slug of condensate is picked up by fast moving steam traveling over the surface of the condensate. Since water hammer can cause extensive damage to the system, the exact capacity of each trap effected by steam pressure reduction must be determined.

MODELING TECHNIQUES:

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy savings for ECO-M12 were derived from "Improving Boiler Efficiency" by S. G. Dukelow. Boiler efficiency is increased by lowering the operating steam pressure, because the flue gases leave the boiler at a lower temperaure.

The saturation temperature of steam at 120 psig is 350°F., and the corresponding flue gas temperature is 450°F. Reducing the operating pressure of the boiler to 80 psig, reduces the saturation temperature of the steam to 324°F., and the corresponding flue gas temperature is reduced to 424°F.

The total heat content or enthalpy of steam at 120 psig is 1,192.4 btu/lb., while 80 psig steam has an enthalpy of 1,186.3 btu/lb. The 80 psig steam also has a higher latent heat content per pound than the 120 psig steam. While the 120 psig steam has more total heat per pound than the 80 psig steam, this heat is never fully realized at the heat exchanger.

As the steam pressure is reduced prior to delivery to the heat exchanger, the extra btu's are converted into superheated steam. This superheated steam is all sensible heat and is promptly dissipated before it can be recovered at the heat exchanger.

The modeling technique assumes that the steam consumption remains constant for the facility, and the cost of producing steam is reduced due to the increased boiler efficiency.

ECO IMPLEMENTATION:

The implementation of ECO-M12 can be accomplished when the existing boilers are replaced. The existing facility is served by three 580 H.P. steam boilers operating at 120 psig steam pressure. We recommend installing two 435 H.P., and one 870 H.P. steam boilers.

The 870 H.P., and one 435 H.P. boiler would be operated at 80 psig pressure, and would serve the space heating requirements of the facility. The remaining 435 H.P. boiler would be operated at 120 psig and would be dedicated to serving the laundry.

SUMMARY:

Since ECO-M12 can be implemented at the time the existing steam boilers are replaced, there are no associated costs for execution, and the energy savings can be realized within the next two years.

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	STEAM PLANT	X HAND	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP	___ COMPUTER ___ CONTRACTOR BID ___ OTHER (SPECIFY)	
ECO MEASURE	ECO M12	COMPUTED BY TGD	CHECKED BY MAW

STEAM PRESSURE	ENTHALPY BTU/LB. OF STEAM	SYSTEM EFFICIENCY	STEAM COST PER 1000 LBS.	ESTIMATED ANNUAL SAVINGS
120 PSIG	1,192.4	74.000%	$5.754	NONE
115 PSIG	1,191.7	74.094%	$5.742	$652
110 PSIG	1,191.0	74.188%	$5.731	$1,249
105 PSIG	1,190.4	74.282%	$5.721	$1,792
100 PSIG	1,189.6	74.376%	$5.709	$2,443
95 PSIG	1,188.8	74.470%	$5.698	$3,040
90 PSIG	1,188.0	74.564%	$5.686	$3,692
85 PSIG	1,187.2	74.658%	$5.675	$4,289
80 PSIG	1,186.3	74.752%	$5.663	$4,941

AVERAGE STEAM USE 148,750 LBS PER DAY

SYSTEM EFFICIENCY CALCULATED FROM:

IMPROVING BOILER EFFICIENCY BY S.G. DUKELOW

SPONSORED BY KANSAS STATE UNIVERSITY AND KANSAS ENERGY OFFICE

CHAPTER 6: EFFECT OF BOILER STEAM PRESSURE ON FLUE GAS TEMPERATURE AND BOILER EFFICIENCY

ECO-M14

SERVICE CONDENSATE RETURN SYSTEM

CONDENSATE RETURN SYSTEM SERVICE: ENERGY CONSERVATION OPPORTUNITY ECO-M14

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M14) analyzes the energy savings associated with reducing the amount of heat transfer through the walls of condensate return piping. The piping transfers heat to its surroundings because of a temperature difference between the fluid, and the ambient space temperature through which it is routed. This loss of heat from the hot condensate to the ambient air in the piping tunnels causes increased use of natural gas at the boiler.

SCOPE:

This Energy Conservation Opportunity (ECO-M14) involves the condensate return piping from building #475 (Castle Building). The condensate return system for this building consists of approximately 700 feet of 6" and 8" steel piping, approximately 600 feet of this piping is uninsulated, and 100 feet of piping will need to be replaced.

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy savings for ECO-M14 were derived by measuring the present condensate return temperature, and estimating the future condensate return temperature by using a computer spreadsheet.

The average daily steam consumption was derived by summing 25% of the average winter rate of 370,000 lbs. per day, and 75% of the average summer rate of 75,000 lbs. per day.

The steam tunnel that exits the west wall of the boiler plant serves the Castle Building #475, which includes the laundry facility. The estimated annual steam load served by this tunnel is 50% of the total system load.

ECO IMPLEMENTATION:

The implementation of this Energy Conservation Opportunity (ECO-M14) requires the replacement of approximately 100 feet of 8" condensate return piping installed at the floor level of the piping tunnel. Various fittings are required along with pipe racks for support of the piping.

400 feet of insulation is required for the 6" dia. piping, and 200 feet of insulation is required for the 8" dia. piping to reduce the amount of heat transfered to the tunnel air. A difficulty factor has been added to the construction cost for limited work area, and accessability.

The existing condensate piping has holes drilled in the pipe that must be repaired prior to installation of the insulation.

SUMMARY:

The condition of the condensate piping system in the west tunnel is questionable, and may warrant replacement. Energy conservation can be realized without total replacement of this piping system.

CALCULATION SHEET	DATE Mar-90		SHEET 0F 1 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)		
LOCATION			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE SERVICE CONDENSATE RETURN SYSYTEM ECO-M14	COMPUTED BY TGD		CHECKED BY MAW

INIT TEMP	AMB TEMP	INSUL THICK	WIND VEL	PIPE DIA	INSULATION CHARACTERISTIC				PIPE LEN	FLOW #/HR	SPEC HEAT	EMISS	FINAL TEMP	TOTAL HL
					T 1	CON1	T2	CON 2						
212	75	2	1	8.625	460	0.5	100	0.25	700	6200	1.05	0.9	201.1	71,040
212	75	0.001	1	8.625	460	0.5	100	0.25	700	6200	1.05	0.9	154.9	371,640

CALCULATION SHEET	DATE Mar-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE SERVICE CONDENSATE RETURN SYSYTEM ECO-M14	COMPUTED BY TGD	CHECKED BY

120 PSIG STEAM PRESSURE:	1192.4 BTU/LB. ENTHALPY
155°F CONDENSATE RETURN TEMPERATURE:	123 BTU/LB. ENTHALPY
201°F CONDENSATE RETURN TEMPERATURE:	169 BTU/LB. ENTHALPY
SYSTEM EFFCIENCY:	74%
AVERAGE DAILY STEAM CONSUMPTION:	148,750 LBS.
STEAM LOAD SERVED BY WEST TUNNEL:	50%
DAYS PER YEAR:	365

(1192.4 - 123) - (1192.4 - 169) / 0.74 = 62.16 BTU/LB.

(62.16 X 148,750 X .5 X 365)/1,000,000 = 1,687 MBTU/YEAR

CONSTRUCTION COST ESTIMATE	DATE PREPARED Mar-90	SHEET 1 OF 1
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.	ESTIMATOR: TGD	CHECKED BY: MAW

	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
6" DIA. - 2" THICK FIBERGLASS INSULATION	400	LF	$5.87	$2,348	$3.45	$1,380	$3,728
ALUMINUM JACKET	400	LF	$0.54	$216	$2.87	$1,148	$1,364
8" DIA. SCH. 80 STEEL PIPE	60	LF	$37.66	$2,260	$22.00	$1,320	$3,580
2" THICK FIBERGLASS INSULATION	200	LF	$7.25	$1,450	$4.31	$862	$2,312
ALUMINUM JACKET	200	LF	$0.54	$108	$2.87	$574	$682
PIPE RACKS	6	EA	$400	$2,400	$200	$1,200	$3,600
REPAIR HOLES IN PIPING	3	DAYS			$252	$756	$756
8" DIA. TEE	2	EA	$71	$142	$71	$142	$284
8" DIA. 90° ELBOW	2	EA	$100	$200	$140	$280	$480
DEMOLITION	60	LF			$3.95	$237	$237
SUBTOTAL				$9,124		$7,899	$17,023
DIFFICULTY FACTOR 50%					50%	$3,950	$3,950
SUBTOTAL						$11,849	$20,973
CONTINGENCY 10%			10%	$912	10%	$1,185	$2,097
SUBTOTAL				$10,036		$13,034	$23,070
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$351	13.0%	$1,694	$2,045
DIRECT COST				$10,387		$14,728	$25,115
OVERHEAD AND PROFIT			25%	$2,597	25%	$3,682	$6,279
SUBTOTAL				$12,984		$18,410	$31,394
CONSTRUCTION COST							$31,394

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM14
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	31394.
B. SIOH	$	1884.
C. DESIGN COST	$	1727.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	31505.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	31505.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44		$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	1687.	$ 6883.	11.67	80325.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		1687.	$ 6883.		$ 80325.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 26507.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 6883.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 80325.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.55
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 4.58

ECO-M15

BOILER PLANT MODIFICATIONS

BOILER PLANT MODIFICATIONS:

ENERGY CONSERVATION OPPORTUNITY: ECO-M15

PURPOSE:

The purpose of this Energy Conservation Opportunity (ECO-M15) is to analyze the energy savings that may be realized by implementing the following:

1) Recover heat from the boiler flue gases, and transfer that heat to the boiler feed water.

2) Recover heat from the boiler blowdown cycle, and transfer that heat to the boiler feed water.

3) Install automatic boiler blowdown controls.

4) Increase the efficiency of the three high-pressure steam boilers currently serving the USDB.

5) Change the feedwater chemistry program of the three steam boilers currently serving the USDB.

6) Clean the tubes of the three steam boilers currently serving the USDB.

7) Install oxygen trim controls on the boilers at the USDB.

Within the next two years the (3) existing steam boilers are to be replaced with (3) new steam boilers. The existing boilers are capable of producing 20,000 lbs./hr each when burning natural gas. Using fuel oil as an energy source the boilers will produce steam at the rate of 10,000 lbs./hr. each. (2) 15,000 lb./hr. and (1) 30,000 lb./hr. boilers will provide operating flexibility to the facility. (1) 15,000 lb./hr. boiler can be operated at 120 psig pressure and dedicated to serve the laundry. The 30,000 lb./hr. and one of the 15,000 lb./hr. boilers would operate at 80 psig and serve the space heating requirements of the USDB. The total capacity of the steam generation system would not be changed, and the maximum hourly load of 30,000 lb./hr. could still be satisfied while burning fuel oil.

SCOPE:

This Energy Conservation Opportunity (ECO-M15) involves three existing forced draft type, natural gas fired, steam boilers located in the boiler plant Building #474. The boilers are capable of 20,000 lbs./hr. continuous steam production when using natural gas as an energy source.

Each boilers is capable of 10,000 lbs./hr. continuous steam production when using # 6 fuel oil as an energy source. Field measurements indicate that the flue gas temperature of the boilers is 450° F using natural gas.

Steam is delivered to the various buildings by a system of insulated high pressure steam pipes located in tunnels. Generally, the steam pressure is reduced at the individual buildings and is used for space heating by one of two different means.

Some of the buildings utilize air handlers that are equipped with steam heating coils. Other buildings supply the steam to a heat exchanger where it is used to raise the temperature of the hot water, which is circulated by an electrically driven pump through terminal units. Terminal units consist of convectors, fan coils or air handlers equipped with hot water coils.

Condensate is returned through piping located in the same system of tunnels by gravity to the condensate pumps located in the boiler plant. The condensate pumps lift the condensate up to the deaerator, where it is heated to 220°F to release oxygen before being returned to the boilers. Boiler make-up water is also introduced into the system at the deaerator. The boiler feed pumps discharge the feedwater into the boilers through the boiler pump controls.

Outside air used for combustion in the boilers is introduced into the boiler plant by one or more different means as follows:

a. Manually opening an overhead door.

b. Manually opening windows.

c. Airflow from the piping tunnels into the boiler plant.

The products of combustion are carried by insulated breeching to a masonry stack adjacent to the boiler plant structure, where they are discharged to the atmosphere.

1) Installing a boiler fuel economizer reduces fuel consumption by extracting heat from hot flue gases and transferring that heat to another source where the heat can be reclaimed in one of several different ways:

   a. To preheat the boiler feedwater.

   b. To preheat the make-up air used for combustion.

   c. To heat domestic hot water.

   We will consider utilizing this heat to preheat the boiler feedwater. Utilization of the extracted heat to preheat combustion air is not an option, because there is not a single fixed outside air intake duct, plenum or opening available for installation a heat exchanger coil.

Utilizing the heat for domestic water heating purposes is not viable. Domestic water heating is accomplished at the various buildings inside the USDB facility, and not at a central location such as the boiler plant.

2) A blowdown heat recovery unit reduces fuel consumption in two separate ways:

a. First, by extracting heat from the hot boiler blowdown water, and by using that energy to heat the make-up water for the boilers.

b. A second means by which the unit reduces fuel consumption is by capturing the flash steam which is produced when the boiler water pressure is reduced from the boiler operating pressure to atmospheric pressure and transferring that steam to the deaerator.

3) Installing automatic boiler blowdown controls is not a valid energy conservation opportunity. The (3) existing steam boilers are presently equipped with automatic blowdown controls. The existing blowdown system operates on an intermittent cycle controlled by a measurement of the total dissolved solids.

The existing blowdown rate for the steam boilers is approximately 0.7 gallons per minute. The existing blowdown controls are adequate, and there is not an opportunity to conserve energy by modifying, or replacing these existing controls.

4) An increase in boiler efficiency can be accomplished in two ways:

a. Reducing stack losses.

b. Reducing heat lost from the outside surfaces of the boilers.

Reducing stack losses means reducing flue gas temperature. This can be accomplished by controlling the amount of combustion air allowed into the combustion chamber. Any increase over the optimum air quantity for combustion will reduce not the efficiency of combustion itself, but rather the rate of heat transfer to the boiler of furnace; an increase in the stack temperatures will also occur.

The ideal amount of excess air is approximately 15%. Field measurements on boilers at the USDB indicated 37% excess air and 80% combustion efficiency. Oxygen trim controls will be discussed later. Another way to reduce flue gas temperature, which is not directly related to the boilers themselves, is to recover heat from the flue gases. This was discussed in #1.

The only way to reduce heat loss from the outside surfaces of the boilers is to apply insulation to them. Because the boilers are to be replaced soon, the cost of insulating the existing boilers would outweigh any energy savings that would be realized in the short time before they are replaced.

5) Improving the boiler feedwater chemistry program so that the boilers operate more efficiently due to cleaner tubes and less frequent blowdowns is not a valid energy conservation opportunity.

Currently, a chemical water treatment system is used that employs a polymer which attaches itself to the suspended solids and forms large "clumps". This action makes the blowdown process efficient, resulting in a minimum amount of water flow to accomplish the removal of the solids and scale from the steam system.

6) Annual cleaning of the boiler tubes in order to increase boiler efficiencies, thereby decreasing boiler energy consumption is currently a part of the maintenance of the steam system.

The water tubes for the (3) existing steam boilers are acid cleaned yearly, and a visual inspection of boiler #3 showed the tube walls to be clean and free from deposits, or scale accumulation

7) Installing oxygen trim controls on the boilers allows the quantity of air introduced with the fuel to be adjusted to its optimum operating point. This air quantity is important because too little air results in incomplete combustion and reduced efficiency.

Too much air allows complete combustion, but wastes heat up the stack by increasing the volume of exhaust. Because the inefficiency of incomplete combustion is much worse than the inefficiency of excess air, the units are adjusted to allow excess air of approximately 40% with a control error band of 35%.

The ideal amount of excess air is approximately 15%. Boiler oxygen trim controls measure the stack temperature, and the amount of excess air in the exhaust gas. The amount of excess air is directly related to these two factors. The oxygen trim control unit automatically adjusts the quantity of air or fuel to keep the excess of air to 15%.

MODELING TECHNIQUES:

Boiler stack economizer calculations were done by hand using an existing feedwater temperature of 220°F from the deaerator, and a new feedwater temperature of 232.6°F. The new feedwater temperature was determined by a manufacturer of econimizers. The savings were estimated by using the difference in enthalpy of the two feedwater temperatures.

The water meter for the make-up water system indicates approximately 3,000 gallons per day is used during the winter months to replenish the water lost due to blowdown and system leakage. We must estimate that 83% of the make-up water is blowdown, and the remaining 17% is leakage.

There is no water meter available that can measure water flow in the process of flashing off steam as its pressure is reduced from 120 psig to atmospheric pressure. Nor could a water meter withstand the 350°F saturation temperature of 120 psig steam and the solids or scale coming from a pressurized boiler for any length of time.

83% of 3,000 gallons equals approximately 2,500 gallons of blowdown per day for the winter months. The winter steam production for the USDB is 370,000 pounds per day, and using 2,500 gallons as the blowdown quanity the blowdown rate is equal to 5% of the boiler steam production.

The yearly average steam production is estimated to be 148,750 lbs./day, or 6,198 lbs./hour. This number is used for calculation of energy savings for heat recovery for the boiler blowdown.

Boiler oxygen trim control calculations were done by hand. First, field measurements of boiler combustion air were taken with a combustion analyzer. This device monitors oxygen, carbon dioxide, and percent of excess air to calculate a combustion efficiency.

Next, a new combustion efficiency was found for 15% excess air, the amount allowed into the combustion chambers by the oxygen trim controls. The difference between the two combustion efficiencies was the percentage of energy savings.

ECO IMPLEMENTATION:

The construction cost estimate for the boiler stack economizer includes the material and installation costs for the economizer coil unit, piping modifications, pipe insulation, valves and accessories.

The construction cost estimate for the blowdown heat recovery includes the material and installation costs for the packaged heat recovery unit, piping modifications, pipe insulation, valves and accessories.

Oxygen trim controls can either be purchased as part of a package with future boilers or installed (at a higher cost) on the existing boilers. For the purpose of this study, we are assuming installation of the controls on the existing boilers.

SUMMARY:

The project costs shown in Table M15-1 are the construction costs plus 6% SIOH. Each valid option in this ECO was considered as a separate project.

The energy savings associated with the implementation of this ECO is also shown in Table M15-1 on a MBTU per year and dollars per year savings as determined by hand calculations.

We recommend installing blowdown heat recovery on the (3) new boilers at the time of replacement, because the payback period does not warrant the installation on the present boilers.

We recommend using a boiler stack fuel economizer on the new 15,000 lb./hr. boiler serving the laundry with 120 psig steam. The saturated temperature for 120 psig steam is 350° F., and the flue gas must be approximately 450° F. to transfer the heat from the fuel to the water in the boiler. This flue gas temperature is higher than the temperature for the (2) 80 psig boilers. The laundry boiler also operates on a year-round basis.

The cost for blowdown heat recovery is $24,370 and the savings to investment ratio is 1.79, and the simple payback is 6 1/2 years. The cost for the boiler stack economizer is $22,852 with a savings to investment ratio is 1.92, and the simple payback is 6 years.

Oxygen trim controls were found to have a payback of 2.67 years. However, if the boilers are to be replaced within a period of time that is close to this, we recommend that the controls not be purchased until the new boilers are purchased. At that time, the controls can be bought as part of a package with the boilers.

Project	Energy Savings (MBTU/yr)	Energy Savings ($/yr)	Project Cost ($)	Simple Payback (years)	Savings to Investment Ratio
Economizer H.R.	925	3,774	22,852	6.08	1.92
Blowdown H.R.	917	3,741	24,370	6.54	1.79
O_2 Trim Controls	3,397	13,860	39,077	2.67	4.37

Table M15-1

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION		X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECONOMIZER ECO-M15	COMPUTED BY TGD	CHECKED BY

220.0°F BOILER FEEDWATER TEMPERATURE:	188.0 BTU/LB. ENTHALPY
232.6°F BOILER FEEDWATER TEMPERATURE:	200.6 BTU/LB. ENTHALPY
SYSTEM EFFCIENCY:	74%
AVERAGE DAILY STEAM CONSUMPTION:	148,750 LBS.
DAYS PER YEAR:	365

(200.6 - 188.0) / 0.74	=	17.03	BTU/LB.
(17.03 X 148,750 X 365)/1,000,000	=	925	MBTU/YEAR

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION		X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	BLOWDOWN HEAT RECOVERY ECO-M15	COMPUTED BY TGD	CHECKED BY MAW

BLOWDOWN INLET TEMPERATURE:	350°F
BLOWDOWN OUTNLET TEMPERATURE:	100°F
TEMPERATURE DIFFERNTIAL:	250°F
AVERAGE STEAM PRODUCTION:	148,750 LBS./DAY
AVERAGE STEAM PRODUCTION PER HOUR:	6,198
BLOWDOWN RATE:	5%
SYSTEM EFFICIENCY:	74%
MBTU:	1,000,000
24 HOURS x 365 DAYS =	8760

[(250 x 6198 x 0.05) / (0.74 x 1,000,000)] x 8760 = 917 OK

C_p water = 1 Btu/# °F

917 MBTU SAVINGS PER YEAR

$$\frac{°F \times \#\cancel{steam}/\cancel{HR} \times \frac{\#\ \text{BLOWDOWN WATER}}{\cancel{\#\ steam}}}{\eta \times \text{MBTU}} \times \cancel{HR}$$

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	FORT LEAVENWORTH, KANSAS	X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M15 O2 TRIM CONTROLS	COMPUTED BY BMS	CHECKED BY MAW

BUILDING 474 - CENTRAL HEATING PLANT

TEST DATA, BOILER #2

% OXYGEN	6.3 %
STACK TEMPERATURE	450 ° F
% EXCESS AIR	37. %
EFFICIENCY	80.50%
%CO 2	8.3 %

STEAM PRODUCTION, ACCORDING TO BOILER PLANT OPERATORS:

SUMMER	75,000 LBS/DAY
WINTER	370,000 LBS/DAY
AVERAGE (CALCULATED)	148,750 LBS/DAY

BOILER TRIM CONTROL REDUCES EXCESS AIR TO 15%

FROM "GAS COMBUSTION EFFICIENCY CHART" PUBLISHED BY COOPERATIVE EXTENSION SERVICE, KANSAS STATE UNIVERSITY, MANHATTAN KS.:

15% EXCESS AIR AT 317°F = 84.50% COMBUSTION EFF.

84.50% - 80.50% = 4.00% INCREASE IN COMB. EFF.

ENTHALPY OF STEAM LEAVING BOILERS	1192.4 BTU/LB
ENTHALPY OF CONDENSATE RETURNING TO BOILERS	128 BTU/LB
ENTHALPY DIFFERENCE	1064.4 BTU/LB

148,750 LBS/DAY X 1,064 BTU/LB X 365 DAYS/YR X 0.000001 MBTU/BTU =

57,769 MBTU/YR.

THIS TRANSLATES TO GAS CONSUMPTIONS OF

57,769 / 80.50% = 71,763 MBTU/YR.

AND

57,769 / 84.50% = 68,366 MBTU/YR. WITH O2 TRIM CONTROLS.

SAVINGS

71,763 - 68,366 = 3,397 MBTU/YR.

4.08 X 3,397 = $13,860 PER YEAR

[illegible]
TULSA, OKLAHOMA

RETROMISER FUEL ECONOMIZER

OVERALL PERFORMANCE

COUNTER CURRENT FLOW
FLUID CIRCULATED IN TUBES IS WATER

HEAT EXCHANGED	175591.	BTU/HR
U EXTERNAL	6.573	BTU/HR-SQFT-F
U BARE TUBE	61.962	BTU/HR-SQFT-F
LMTD	118.1	DEG F
BARE TUBE SURFACE	27.	SQFT
MAX FIN TEMP	311.	DEG F
MAX TUBE WALL TEMP	258.	DEG F
BOILER FLUID SAT TEMP	350.	DEG F

OVERALL CONSTRUCTION

HORIZONTAL GAS FLOW
DIMENSIONS

DEPTH	3'- 7 1/2"
WIDTH	6'-11 1/2"
HEIGHT	2'- 7 5/8"
NOZZLE C-C	1'- 1 1/2"

DRAWING NO RA-208

NO OF SOOT BLOWER LANES	1
NOZZLE SIZE	2.0 IN., 300 RFWN
EFF SURFACE AREA	252. SQFT
WEIGHT OF LIQUID	86. LB
WEIGHT OF UNIT(DRY)	1934. LB

PERFORMANCE SPECIFICATIONS

	TUBE SIDE	GAS SIDE	
FLUID ENTERING	13417.	18423.	LB/HR
TEMP IN	220.0	365.0	DEG F
TEMP OUT	232.6	324.9	DEG F
PRES IN	170.0 PSIG	14.7	PSIA
PRES DROP	1.8 PSI	.23	IN WATER
VELOCITY	4.1	38.4	FT/SEC
MASS VEL	245.2	1.7	LB/SQ FT/SEC
DENSITY	59.435	.0477	LB/CUFT
VISCOSITY	.262	.0202	CPS
SPEC HEAT	1.0045	.2703	BTU/LB F
FOULING FACTOR	.0010	.0010	HR SQFT F/BTU

CONSTRUCTION SPECIFICATIONS
TUBE SIDE

DESIGN PRESSURE	490. PSI
TEST PRESSURE	735. PSI
DESIGN TEMPERATURE	700. DEG
DUCT OPENING	
HEIGHT	1'- 6"
WIDTH	4'- 3"
NUMBER OF TUBES	12
NUMBER OF ROWS	3
TUBES PER ROW	4
PARALLEL STREAMS	1
TUBE PITCH	4.500 IN (SQ)
OUTSIDE DIA	2.000 IN
MIN TUBE WALL	.105 IN
LEN OVERALL	4'-10"
LEN EFF.	4'- 3"
MATERIAL	SA-178-A
FIN THICKNESS	.060 IN
PITCH	4.00 FINS/IN
HEIGHT	.750 IN
MATERIAL	C/STL
INSULATION	MIN WOOL
SIDES	2.0 IN
HEADER BOX	2.0 IN
INTERMEDIATE TUBE SUPPORTS	
QUANTITY	0
TYPE	LATTICE
CASING	
THICKNESS	.1340 IN
MATERIAL	C.S.
TYPE OF RETURN	180 DEG. BEND

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM15
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	22852.
B. SIOH	$	1371.
C. DESIGN COST	$	1257.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	22932.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	22932.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	925.	$ 3774.	11.67	44043.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		925.	$ 3774.		$ 44043.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 14534.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 3774.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 44043.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.92
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.08

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM15
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	24370.
B. SIOH	$	1462.
C. DESIGN COST	$	1340.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	24455.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	24455.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	917.	$ 3741.	11.67	43657.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		917.	$ 3741.		$ 43657.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 14407.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ______
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 3741.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 43657.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.79
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.54

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM15O2
ANALYSIS DATE: 03-28-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	36865.
B. SIOH	$	2212.
C. DESIGN COST	$	2028.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	36995.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	36995.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	3397.	$ 13860.	11.67	161746.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		3397.	$ 13860.		$ 161746.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 53376.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 13860.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 161746.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 4.37
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.67

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 1 OF 1

PROJECT: USDB ENERGY STUDY

LOCATION: FORT LEAVENWORTH, KS

ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP

DRAWING NO.: ECONOMIZER ECO-M15

ESTIMATOR: TGD

CHECKED BY:

BASIS FOR ESTIMATE

- X CODE A (NO DESIGN COMPLETED)
- CODE B (PRELIMINARY DESIGN)
- CODE C (FINAL DESIGN)
- OTHER (SPECIFY)

	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BOILER STACK ECONOMIZER	1	EA	$8,345	$8,345	$3,500	$3,500	$11,845
2" BOILER FEEDWATER PIPING	200	LF	$2.36	$472	$5.50	$1,100	$1,572
1 1/2" THICK PIPE INSULATION	200	LF	$3.21	$642	$1.81	$362	$1,004
2" BALL VALVES	8	EA	$68	$544	$41	$328	$872
THERMOMETERS	2	EA	$55	$110	$7.55	$15	$125
PRESSURE GAUGES	2	EA	$70	$140	$6.15	$12	$152
SUBTOTAL				$10,253		$5,317	$15,570
CONTINGENCY 10%			10%	$1,025	10%	$532	$1,557
SUBTOTAL				$11,278		$5,849	$17,127
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$395	13.0%	$760	$1,155
DIRECT COST				$11,673		$6,609	$18,282
OVERHEAD AND PROFIT			25%	$2,918	25%	$1,652	$4,570
SUBTOTAL				$14,591		$8,261	$22,852
CONSTRUCTION COST							**$22,852**

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED Mar-90	SHEET 1 OF 1
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: BLOWDOWN HEAT RECOVERY ECO-M15	ESTIMATOR: TGD	CHECKED BY: MAW

	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BLOWDOWN RECOVERY UNIT	1	EA	$9,900	$9,900	$4,950	$4,950	$14,850
2" BLOWDOWN PIPING	100	LF	$2.36	$236	$5.50	$550	$786
1 1/2" THICK PIPE INSULATION	100	LF	$3.21	$321	$1.81	$181	$502
2" BALL VALVES	3	EA	$68	$204	$41	$123	$327
THERMOMETERS	2	EA	$55	$110	$7.55	$15	$125
SUBTOTAL				$10,771		$5,819	$16,590
CONTINGENCY 10%			10%	$1,077	10%	$582	$1,659
SUBTOTAL				$11,848		$6,401	$18,249
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$415	13.0%	$832	$1,247
DIRECT COST				$12,263		$7,233	$19,496
OVERHEAD AND PROFIT			25%	$3,066	25%	$1,808	$4,874
SUBTOTAL				$15,329		$9,041	$24,370
CONSTRUCTION COST							**$24,370**

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED Mar-90	SHEET 1 OF

PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)
DRAWING NO.: NONE	ESTIMATOR: BMS — CHECKED BY: MAW

ECO-M15	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
OXYGEN TRIM CONTROL	3	EA	$2,100	$6,300	$5,985	$17,955	$24,255
SUBTOTAL				$6,300		$17,955	$24,255
CONTINGENCY 10%			10%	$630	10%	$1,796	$2,426
SUBTOTAL				$6,930		$19,751	$26,681
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$243	13.0%	$2,568	$2,811
DIRECT COST				$7,173		$22,319	$29,492
OVERHEAD AND PROFIT			25%	$1,793	25%	$5,580	$7,373
SUBTOTAL				$8,966		$27,899	$36,865
CONSTRUCTION COST							**$36,865**

ENG. FORM 150
1AVC-59

ECO-M24

CONVERT FROM STEAM TO HOT WATER

CONVERT STEAM TO HOT WATER

ENERGY CONSERVATION OPPORTUNITY: ECO-M24

PURPOSE:

The purpose of this Energy Conservation Opportunity M24 is to analyze the energy savings that may be obtained by converting the existing high pressure steam system to a hot water heating system. High temperature hot water system are desirable because of reduced thermal losses and better control. Line losses such as leaks, thermal transmission and trap blow through make steam systems less efficient. New Hot Water Boilers are more efficient at partial loads than the existing Steam Boilers located at the USDB.

SCOPE:

ECO-M24 includes replacing the portion of existing steam system used for space heating and replacing it with a hot water heating system. Some existing steam capacity will need to remain to handle the laundry and the domestic hot water system. The application of this project was considered for the following buildings:

Building	463	Building	475B
Building	464	Building	475C
Building	465	Building	475D
Building	466	Building	475E
Building	472	Building	475F
Building	473	Building	475G
Building	475	Building	475H
Building	475A		

New supply and return piping will be added and connected to the existing hot water systems in each building. Steam coils in Castle buildings will be removed and replaced with hot water coils, controls, and connecting piping.

MODELING TECHNIQUES:

The modeling techniques used to simulate this ECO were using the assumption that a Savings to Investment Ratio of at least 1would be required. It is difficult to estimate the exact efficiencies of both system without a complete design so an alternative approach was taken. First a cost estimate of the new hot water system was generated using the heating loads obtained by the computer models created for this study. The project cost, the yearly pumping costs and the fuel costs were entered into the Life Cycle Cost Analysis program. The energy saving in MBTU's was adjusted to obtain an SIR of 1. The existing heating loads divided by the energy saving required gives the total improved efficiency of the hot water system. This improvement in efficiency of 83% is not obtainable thus eliminating the cost effectiveness of this ECO.

ECO IMPLEMENTATION:

Because of the large construction cost and yearly operating costs involved with this ECO a payback was not obtainable.

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION		X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M24	COMPUTED BY RGB	CHECKED BY MAW

HAND CALCULATION OF ENERGY SAVINGS ASSOCIATED WITH HOT WATER HEATING SYSTEM
HOT WATER SYSTEM CALCULATED TO SERVE ALL BUILDING INCLUDED IN THIS STUDY

PROJECT COST = $634,367

PUMP ENERGY
75 HP. MOTOR
1 HP = 746 WATTS
75 X 746 = 55.95 KW
HOT WATER PUMP RUN TIME = 4380 HR /YR

ENERGY = 55.95 KW X 4,380 HR = 245,061 KW
= 836.4 MBTU'S

PUMP ENERGY = 836.4 MBTU'S PER YEAR

FROM LIFE CYCLE COST ANALYSIS W/ SIR = 1

REQUIRED YEARLY SAVINGS **=15,300 MBTU OF NATURAL GAS**
= $ 62,424 PER YEAR

PRESENT HEATING ENERGY USAGE / YR **= 18,522 MBTU**
= $ 98,907 PER YEAR

INCREASED EFFICIENCY OF NEW SYSTEM TO OBTAIN SIR = 1

15,300 MBTU / 18,533 MBTU = 83%

REQUIRED 83 % INCREASE IN EFFICIENCY IS NOT POSSIBLE

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M24	COMPUTED BY RGB	CHECKED BY MAW

THE HEATING CAPACITY PER BUILDING IS:

BUILDING	MBH HTG.
450	0.817
463	0.419
464	0.319
465	2.257
466	0.795
472	0.849
473	0.541
475	1.555
475A	0.667
475B	0.464
475C	1.539
475D	1.646
475E	5.317
475F	1.648
475G	1.556
475H	0.446
TOTAL	20.835 MILLION BTUH

INSTALL 3 15 MILLION BTUH HOT WATER BOILERS

USING A HOT WATER TEMPERATURE OF 180° TO 200°
USING A TYPICAL DELTA TEMPERATURE OF 10°F

ENERGY = 20,835,000 BTUH

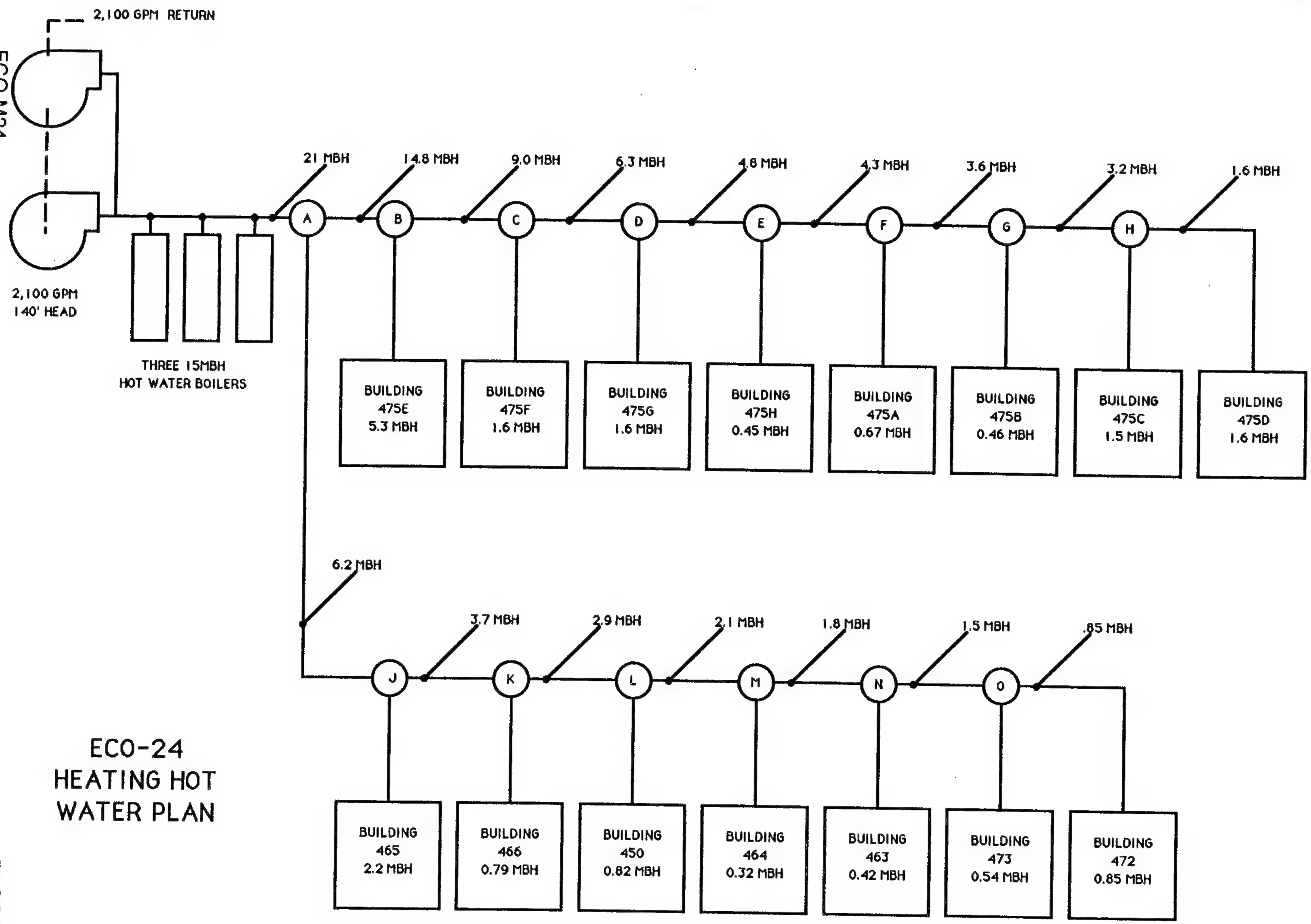
ΔT = 20° F
GPM = (ENERGY) / (ΔT) (500 LB MIN / GAL HOUR)
GPM = 20,835,000 / 10,000
GPM = 2083.5

PUMP TO BE SIZED FOR 2,100 GPM

USING THE FOLLOWING SPREADSHEET, PIPE SIZES, NUMBER OF FITTINGS, AND FRICTION LOSS CAN BE DETERMINED.

THE PUMP WILL BE A 2,100 GPM, 140' HEAD END SUCTION.

ECO-M24



ECO-24
HEATING HOT
WATER PLAN

HEATING HOT WATER PIPING WORKSHEET

PATH DESCRIPTION	MILL BTUH	GPM	PIPE SIZE	FEET	ELL	FRCT/ ELL	ELL FRCT	TEE	FRCT/ TEE	TEE FRCT	VALVE	FRCT/ VALVE	VALVE FRCT	TOTAL FEET	HEAD 4'/100'
PUMP TO BOILER	21	2100	12"	20	10	7.0	70	3	24.0	72	6	3.2	19.2	181.2	**7.2**
BOILER TO A	21	2100	12"	60	3	7.0	21	1	24.0	24	2	3.2	6.4	111.4	**4.5**
A TO B	13	1330	10	200	9	5.7	51.3	1	18.0	18	1	3.2	3.2	272.5	10.9
B TO BLDG 475E	5	530	8"	20	2	4.2	8.4		12.0	0	2	2.9	5.8	34.2	1.4
B TO C	8	800	10"	450	2	4.2	8.4	1	12.0	12	1	2.9	2.9	473.3	18.9
C TO BLDG 475F	2	160	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
C TO D	6	630	8"	40	2	4.2	8.4	1	12.0	12	1	2.9	2.9	63.3	2.5
D TO BLDG 475G	2	160	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
D TO E	5	480	6"	40	2	4.2	8.4	1	12.0	12	1	2.9	2.9	63.3	2.5
E TO BLDG 475H	2	160	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
E TO F	4	430	6"	40	2	3.4	6.8	1	9.4	9.4	1	2.8	2.8	59	2.4
F TO BLDG 475A	1	67	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
F TO G	4	360	4"	40	2	3.4	6.8	1	9.4	9.4	1	2.8	2.8	59	2.4
G TO BLDG 475B	0	46	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
G TO H	3	320	4"	40	2	3.4	6.8	1	9.4	9.4	1	2.8	2.8	59	2.4
H TO BLDG 475C	2	150	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
H TO BLDG 475D	2	160	2"	20	2	3.4	6.8		9.4	0	2	2.8	5.6	32.4	1.3
A TO J	6	600	8"	610	12	5.7	68.4	1	18.0	18	1	3.2	3.2	699.6	28.0
J TO BLDG 465	2	225	4"	20	2	3.6	7.2		12.0	0	2	2.6	5.2	32.4	1.3
J TO K	4	370	4"	190	9	5.0	45	1	12.0	12	1	3.1	3.1	250.1	10.0
K TO BLDG 466	1	79	2"	40	2	5.0	10	1	6.0	6	1	3.1	3.1	59.1	2.4
K TO L	3	291	4"	210	9	5.0	45	1	6.6	6.6	1	3.1	3.1	264.7	10.6
L TO BLDG 450	1	82	2"	80	2	3.4	6.8		6.0	0	2	2.8	5.6	92.4	3.7
L TO M	2	210	4"	100	4	5.0	20	2	12.0	24	1	3.1	3.1	147.1	5.9
M TO BLDG 464	0	32	2"	20	4	5.0	20	2	6.0	12	1	3.1	3.1	55.1	2.2
M TO N	2	180	2"	100	4	5.0	20	2	6.6	13.2	1	3.1	3.1	136.3	5.5
N TO BLDG 463	0	42	2"	20	4	5.0	20	2	6.0	12	1	3.1	3.1	55.1	2.2
N TO O	2	150	2"	50	4	5.0	20	2	6.6	13.2	1	3.1	3.1	86.3	3.5
O TO BLDG 473	1	54	2"	20	4	5.0	20	2	6.0	12	1	3.1	3.1	55.1	2.2
0 TO BLDG 472	1	82	2"	150	8	4.2	33.6	2	6.0	12	2	2.9	5.8	201.4	8.1

LARGE PRESSURE DROP PATH TOTAL 69.1

TOTAL PRESSURE DROP INCLUDING RETURN **X (2) 138.2**

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	634367.
B. SIOH	$	38062.
C. DESIGN COST	$	34890.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	636587.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	636587.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	-836.	$ -10400.	8.69	-90376.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	15300.	$ 62424.	11.67	728488.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		14464.	$ 52024.		$ 638112.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 210577.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 52024.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 638112.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.00
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 12.24

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/30/90	SHEET 1 OF 2
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR RGB	CHECKED BY MAW

ECO-M10 CENTRAL PLANT COOLING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
15,000 MBTU HOT WATER BOILER	3	EA	45500.00	$136,500	10000.00	$30,000	$166,500
BOILER START UP	3	EA			3000.00	$9,000	$9,000
2100 GPM PUMP, 140' HEAD @75 hp	2	EA	3300.00	$6,600	780.00	$1,560	$8,160
12" BLACK STEEL PIPE, HANGERS, INSUL~	160	FT	31.10	$4,976	40.25	$6,440	$11,416
10" BLACK STEEL PIPE, HANGERS, INSUL~	1300	FT	26.20	$34,060	28.12	$36,556	$70,616
8" BLACK STEEL PIPE, HANGERS, INSUL	1340	FT	18.18	$24,361	22.17	$29,708	$54,069
4" BLACK STEEL PIPE, HANGERS, INSUL~	1360	FT	12.20	$16,592	18.19	$24,738	$41,330
2" BLACK STEEL PIPE, HANGERS, INSUL ~	400	FT	8.60	$3,440	10.25	$4,100	$7,540
12" BLACK STEEL ELL	13	EA	120.00	$1,560	210.00	$2,730	$4,290
10" BLACK STEEL ELL	14	EA	80.00	$1,120	160.00	$2,240	$3,360
8" BLACK STEEL ELL	13	EA	66.00	$858	135.00	$1,755	$2,613
4" BLACK STEEL ELL	10	EA	26.00	$260	45.00	$450	$710
2" BLACK STEEL ELL	10	EA	15.00	$150	25.00	$250	$400
12" BLACK STEEL TEE	1	EA	150.00	$150	290.00	$290	$440
10" BLACK STEEL TEE	1	EA	132.00	$132	260.00	$260	$392
8" BLACK STEEL TEE	3	EA	91.00	$273	220.00	$660	$933
6" BLACK STEEL TEE	3	EA	50.00	$150	185.00	$555	$705
4" BLACK STEEL TEE	3	EA	27.00	$81	115.00	$345	$426
10" BUTTERFLY VALVE	4	EA	200.00	$800	120.00	$480	$1,280
8" BUTTERFLY VALVE	2	EA	140.00	$280	110.00	$220	$500
4" GATE VALVE	10	EA	105.00	$1,050	27.00	$270	$1,320

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/30/90	SHEET 2 OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE: X CODE A (NO DESIGN COMPLETED); CODE B (PRELIMINARY DESIGN); CODE C (FINAL DESIGN); OTHER (SPECIFY)	
LOCATION: FORT LEAVENWORTH, KS		
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: RGB	CHECKED BY: MAW

ECO-M10 CENTRAL PLANT COOLING	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDINGS 475C,D,F,G STEAM COIL REPLACEMENT	8	EA	1750.00	$14,000	435.00	$3,480	$17,480
BUILDINGS 475C,D,F,G STEAM COIL DEMOLITION	8	EA			395.00	$3,160	$3,160
EXISTITING CONDENSATE LINE DEMOLITION	2400	LF			6.60	$15,840	$15,840
PARTIAL EXISTING STEAM PIPE DEMOLITION	1000	LF			6.60	$6,600	$6,600
SUBTOTAL				$247,393		$181,687	$429,080
CONTINGENCY 10%			10%	$24,739	10%	$18,169	$42,908
SUBTOTAL				$272,132		$199,856	$471,988
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$9,525	13.0%	$25,981	$35,506
DIRECT COST				$281,657		$225,837	$507,494
OVERHEAD AND PROFIT			25%	$70,414	25%	$56,459	$126,873
SUBTOTAL				$352,071		$282,296	$634,367
CONSTRUCTION COST							$634,367

ENG. FORM 150
1AVC-59

ECO-M25

CONVERT FROM STEAM TO COGENERATION

COGENERATION POTENTIAL AT THE USDB

ENERGY CONSERVATION OPPORTUNITY: ECO-25

PURPOSE:

This ECO was investigated to determine the potential cost savings provided by a natural gas cogeneration system. Cogeneration is the practice of generating electricity on-site with an engine-generator set, and recovering the heat from the engine to produce steam or hot water. The steam is used for heating, or processes. At the USDB, those processes are the laundry and kitchen facilities.

SCOPE:

An analysis of the economics of a cogeneration system requiring investigation of, system configuration, fuel prices, financing, fuel availability, and energy requirements. Because of the large capital investment, (0.5 to 5 million dollars) and the impact of operating costs, a very detailed analysis must be performed before funding is considered. The scope of this study is to determine if the investment in a complete cogeneration feasibility study is justified. The cogeneration system would provide electricity for the entire Disciplinary Barracks. The system would be located in the existing boiler plant and be tied into the existing steam system.

CONSIDERATIONS:

In most cases, the feasibility of cogeneration depends on the facility electrical and thermal loads, and how they interrelate. This is especially true when the cost of both electricity and gas are moderate, as they are at the USDB. A natural gas fired system was the only system considered because of the low cost of gas compared to fuel oil or coal in this region.

The thermal load is much greater than the electrical load. A gas turbine cogeneration system would have the most desirable thermal to electrical output for this load situation. A gas turbine would be capable of generating the high pressure steam required at the USDB and providing all of the electricity for the USDB and some additional for the main Post.

Another approach would be to install.a gas reciprocating engine cogeneration system. This type of system has a high electrical output compared to thermal load, but the excess power can be absorbed by the grid serving the rest of the Post. The main drawback of the reciprocating engine systems is that the majority of the thermal output is in engine jacket heat. This temperature is usually around 350°F, which results in either high temperature hot water or low pressure 15 psig steam. Because all of the steam generated at the USDB is 120 psig, there is no real use for the steam generated.

Because the main Post is capable of using excess electricity,the major obstacle to an efficient cogeneration operation at the USDB is the variability of the thermal load. The base load that operates year-round is the laundry facility, which only operates 8 to 10 hours during the day. In the summer, the steam load drops to almost nothing at night. The most efficient system offering the best return on investment would be a cogeneration system tied into a central plant with absorption chillers using the waste heat for cooling purposes.

Table M25-1 indicates the energy use analysis for a gas turbine engine cogeneration system installed at the USDB. The system is base loaded to provide steam to the laundry facility during the day during summer and winter, and space heating during night in the winter. The KW size of the unit was changed up and down to maximize savings. An 800 KW provides the most energy savings. A Payback Analysis shown below.

PAYBACK ANALYSIS:

Assumptions

Electrical Requirements	800 KW
Capital Investment ($1500/KW)	$1.2 Million
Hours of Operation	6570 Hours
Natural Gas Costs	$4.08/MBTU
Electricity Cost from Grid	4.25¢/KWH
Heat Rate	14,000 BTU/KWH

Economic Analysis

Cost Items		Savings	
Fuel	$282,950	Elec. Savings	$136,435
O&M	$20,867	Thermal Savings	$224,519
Total	$303,816	Total	$361,954

Net Savings Per Year $58,138

Simple Payback: 21 years

Heat Rate	14000	Btu/Kwh
Cogen Size	800	KW
Eff. Stm Prod	60%	
Cost of Fuel	$4.08	MBTU
Cost of Exist Stm.	$5.50	MBTU
Cost of Exist Elec	$0.0425	Kwh

	Hrs/Day Operation	Days/ Month	Hrs/Month Operation	USDB Thermal Load MBTU	USDB Electical Load Kwh	Cogen. Therm Energy Available MBTU	Cogen. The Energy Used MBTU	Cogen. Elec. Energy Used Kwh
January	24	31	744	10478	265000	5000	5000	595200
February	24	28	672	9520	237000	4516	4516	322560
March	24	31	744	9300	270000	5000	5000	357120
April	12	30	360	4500	240000	2419	2419	172800
May	12	31	372	2418	240000	2500	2418	178560
June	12	30	360	2250	340000	2419	2250	172800
July	12	31	372	2387	384000	2500	2387	178560
August	12	31	372	2387	374000	2500	2387	178560
September	12	30	360	2340	280000	2419	2340	172800
October	12	31	372	2449	223000	2500	2449	178560
November	24	30	720	6300	240000	4838	4838	345600
December	24	31	744	12028	250000	5000	5000	357120
			6192				41003	3210240

Fuel Cost of Cogeneration Unit.		$282,950	Elec. Saved	$136,435
O&M Cost =	0.0065 per Kwh	$20,867	Steam Saved	$225,519
Total Operating Cost		$303,816	Total Saved	$361,954

Dollar Savings Per year $58,138 per year

TABLE M25-1

ECO-M26

REDUCE HOT WATER TEMPERATURE

REDUCE HOT WATER TEMPERATURE

ENERGY CONSERVATION OPPORTUNITY: ECO-M26

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M26) analyzes the energy savings associated with reduction of the domestic hot water temperature. The implementation of this project will not change the number or capacity of any of the hot water heating equipment.

SCOPE:

The ECO simulation (ECO-M26) makes changes only to the temperature setpoint of the existing hot water heaters and does not encompass any modification or replacement of any existing equipment. The application of this project was considered for the following buildings and their connecting tunnel:

Building	450	Building	475
Building	463	Building	475A
Building	464	Building	475C
Building	465	Building	475D
Building	466	Building	475E
Building	472	Building	475F
Building	473	Building	475G

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy savings for ECO-M26 were derived from "Guidelines for Saving Energy in Existing Buildings." The domestic hot water temperatures for the above buildings were found to range between 170° and 185°. ASPE suggests a domestic hot water temperature of around 140°. Trends to reduce hot water temperature between 110° and 120° have been stopped because these temperatures have been linked to the proliferation of Legionnaires' Disease. An energy savings can be seen by reducing the domestic hot water temperature. Tables M26-1a and M26-1b show the BTUH loss per lineal foot of pipe for different water temperatures. Tables M26-2a and M26-2b use a reduced hot water temperature of 140° to show the energy savings on a per lineal foot bases. The lineal feet of pipe for each building was field estimated to calculate the total possible energy savings in line losses because of reduced hot water temperature.

Domestic water within the USDB is always mixed to a using temperature of under 140°. The equation for mixed water temperature is:

$$t_m = (Q_1 \times t_1)+(Q_2 \times t_2) / Q_1 + Q_2$$

t_m= temperature of the mixture
t_1 = temperature of flow Q_1
t_2 = temperature of flow Q_2

Using a constant (tm) and (t_2) and comparing a range of hot water temperatures (t_1) to the existing hot water temperature it can be seen that as the hot water temperature drops the flow of hot water increases while the cold water flow decreases. The energy usage stays the same because of the energy savings of not having to heat the water to as high a temperature is offset by the fact that more hot water is used. Actual calculations are shown in Table M26-3.

ECO IMPLEMENTATION:

The implementation of this ECO consists of having the USDB maintenance staff change the setpoint for all the hot water heaters within the DB to 140°. This will show an energy savings with no cost to the USDB.

SUMMARY:

Reducing the Domestic Hot Water from 180° to 140° will reduce the amount of heat energy radiating from the hot water piping to its surroundings. The reduction in temperature will also decrease the total capacity of the hot water system. This may cause problems which would call for added capacity or the return to a higher temperature. ECO-M30 also reduces radiation loss in domestic hot water piping by insulating all bare pipe within the USDB. If M30 is implemented it will reduce the effectiveness of this ECO. ECO-M26 does not effect the amount of heat energy consumption at the point of use.

Location	Cost Savings	Project Cost of Construction
475	$92	$0
Castle Domiciles	$210	$0
475E	$134	$0
Tunnels	$299	$0

CALCULATION SHEET	DATE Mar-90	SHEET 1	OF 5
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION		
LOCATION	X HAND		
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	COMPUTER CONTRACTOR BID OTHER (SPECIFY)		
ECO MEASURE ECO-M26	COMPUTED BY RGB	CHECKED BY MAW	

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidlines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
BTUH Loss per lineal foot of bare pipe

Bare Pipe

Pipe Size	180° Water	160° Water	140° Water	120° Water
3/4"	85	70	55	39
1"	105	85	66	46
1-1/4"	126	104	81	57
1-1/2"	150	121	95	67
2"	171	140	110	80
2-1/2"	205	169	133	94

Table M26-1a

Ambient Temperature 68° F
BTUH Loss per lineal foot of insulated pipe

1/2" Fiberglass Insulation

Pipe Size	180° Water	160° Water	140° Water	120° Water
3/4"	20	15	11	8
1"	21	17	12	9
1-1/4"	26	20	16	11
1-1/2"	30	24	19	13
2"	36	30	23	15
2-1/2"	45	35	27	20

Table M26-1b

CALCULATION SHEET		DATE Mar-90	SHEET 2 OF 5
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION		X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M26	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidlines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
BTUH Loss per lineal foot of bare pipe

Bare Pipe

Pipe Size	Btuh loss @ 180°	Btuh loss @ 140°	Btuh Savings	Hours per Year	$ Savings per L.F.
3/4"	85	55	30	4380	$0.70
1"	105	66	39	4380	$0.91
1-1/4"	126	81	45	4380	$1.05
1-1/2"	150	95	55	4380	$1.29
2"	171	110	61	4380	$1.43
2-1/2"	205	133	72	4380	$1.68

Table M26-2a

Ambient Temperature 68° F
BTUH Loss per lineal foot of insulated pipe

1/2" Fiberglass Insulation

Pipe Size	Btuh loss @ 180°	Btuh loss @ 140°	Btuh Savings	Hours per Year	$ Savings per L.F.
3/4"	20	15	5	4380	$0.12
1"	22	17	5	4380	$0.12
1-1/4"	26	20	6	4380	$0.14
1-1/2"	30	24	6	4380	$0.14
2"	36	30	6	4380	$0.14
2-1/2"	45	35	10	4380	$0.23

Table M26-2b

CALCULATION SHEET		DATE Mar-90	SHEET 3 OF 5
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION		X HAND	
		___ COMPUTER	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP	___ CONTRACTOR BID	
		OTHER (SPECIFY)	
ECO MEASURE	ECO-M26	COMPUTED BY RGB	CHECKED BY MAW

REDUCED DOMESTIC HOT WATER TEMPERATURE

Tm= (Q1*T1) +(Q2*T2) / (Q1+Q2)

Tm = mixed water temperature
T1= temperature of fl (Cold Water Temp.)

Assumption:
Tm =110
T1= 40°
T2= X

Tm (°)	T1 (°)	Q1 (Gal.)	T2 (°)	Q2 (Gal.)
110.00	40.00	68.18	180.00	31.82
110.00	40.00	66.67	170.00	33.33
110.00	40.00	65.00	160.00	35.00
110.00	40.00	63.16	150.00	36.84
110.00	40.00	61.11	140.00	38.89
110.00	40.00	58.82	130.00	41.18
110.00	40.00	56.25	120.00	43.75

Table M26-3

CALCULATION SHEET		DATE Mar-90	SHEET 4 OF 5
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M26	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
Length of pipe estimated from field inspection and plans.

Building 475

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	Feet of Insulated	$ Savings per FT.		$ Savings Year
3/4"		$0.70		$0.12		$0
1"		$0.91		$0.12		$0
1-1/4"	60	$1.05		$0.14		$63
1-1/2"	20	$1.29	20	$0.14		$29
2"		$1.29		$0.14		$0

Energy Savings = **$92.00**

Buildings 475C ,475D, 475F, 475G

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	Feet of Insulated	$ Savings per FT.		$ Savings Year
3/4"		$0.70		$0.23		$0
1"		$0.91		$0.23		$0
1-1/4"	200	$1.05	0	$0.28		$210
1-1/2"		$1.29		$0.28		$0
2"		$1.29		$0.28		$0

Energy Savings = **$210.00**

CALCULATION SHEET		DATE Mar-90	SHEET 5 OF 5
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M26	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
Length of pipe estimated from field inspection and plans.

Building 475E

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	Feet of Insulated	$ Savings per FT.		$ Savings Year
3/4"		$0.70		$0.12		$0
1"		$0.91		$0.12		$0
1-1/4"	100	$1.05		$0.14		$105
1-1/2"	20	$1.29	20	$0.14		$29
2"		$1.29		$0.14		$0

Energy Savings = **$134.00**

Tunnels between building 468, 466, 467, 463, 464, 472, 473

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	Feet of Insulated	$ Savings per FT.		$ Savings Year
3/4"		$0.70		$0.23		$0
1"		$0.91	180	$0.23		$41
1-1/4"	60	$1.05	90	$0.28		$88
1-1/2"	55	$1.29	355	$0.28		$170
2"		$1.29		$0.28		$0

Energy Savings = **$299.00**

ECO-M29

DECENTRALIZE HOT WATER SYSTEM

DECENTRALIZE HOT WATER SYSTEM

ENERGY CONSERVATION OPPORTUNITY: ECO-M29

PURPOSE:

The purpose of ECO-M29 is to analyze the energy savings associated with decentralizing the hot water heating system. A central system involves additional branch piping which is a source of heat loss. As hot water sits in the branch piping its temperature is reduced below its desired level. When hot water is needed the faucet is turned on and let run until the water increases to its desired temperature. This waste of water is reduced in a decentralized hot water system due to the fact that the hot water heater is located closer to the point of use. Decentralization of the domestic hot water system will eliminate all connecting hot water piping and the energy loss associated with it.

SCOPE:

ECO-M29 involves removal of the existing central domestic hot water heater located in building 468 and serving buildings 450, 463, 464, 466, 467, 468, 472, and 473. These building will be supplied by individual hot water heaters located in each building:

Building	450	Building	467
Building	463	Building	468
Building	464	Building	472
Building	466	Building	473

New hot water heat exchangers will be connected to the existing steam lines routed through each building. Buildings 450, 463, 473, and 472 have low hot water usage so small electric instantaneous hot water heaters were used. These units are placed at the point of use and only require energy when hot water is being used. The Castle buildings already have individual hot water heat exchangers so they were not applicable for this ECO.

MODELING TECHNIQUES:

The energy loss through branch piping was calculated in Table M29-2. The total gallons of wasted hot water was estimated in Table M29-3 and converted to dollars per year. The sum of these two calculations total the energy savings associated with ECO-M29. A cost estimate for ECO-M29 was prepared using Manufactures Data along with Means Plumbing Cost Data. The cost estimate was prepared per building, but the yearly savings is estimated on a system wide bases. Because of this, Table M29-1 compares the total cost to the total energy savings for this ECO.

ECO IMPLEMENTATION:

The Implementation of ECO-M29 includes the removal of the central hot water system located in building 468. Installation of new hot water heaters are as follows:

Building 450	4-Instantaneous Point of Use Hot Water Heaters
Building 463	5-Instantaneous Point of Use Hot Water Heaters
Building 464	Steam to Hot Water Heat Exchanger
Building 466	Steam to Hot Water Heat Exchanger
Building 467	2-Instantaneous Point of Use Hot Water Heaters
Building 468	Steam to Hot Water Heat Exchanger
Building 472	5-Instantaneous Point of Use Hot Water Heaters
Building 473	5-Instantaneous Point of Use Hot Water Heaters

SUMMARY:

The probable construction cost to implement this ECO is shown in Table M29-1. This project cost is the construction cost as determined on the ECO-M24 Cost Estimate Sheet.

The energy savings associated with the implementation of this ECO by building is shown below in Table M29-1 on a dollars per year savings as determined on ECO-M24 Calculation Sheet. This project cost is the construction cost plus 6% SIOH.

ECO-M24	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
Hot Water System	243	$1,296	$20,740	19.85	.59

Table M29-1

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M30	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Table was developed from fig. 44 of the Guidlines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
Domestic Hot Water Temperature 180°

Pipe Size	Feet of Bare Pipe	BTUH Loss Bare Pipe	Feet of Insulated	BTUH Loss Insulated	Total BTUH Loss	Hours per Year	$ Savings per Year
3/4"	0	85	0	19	0	8760	$0
1"	15	105	75	23	3300	8760	$154
1-1/4"	15	126	75	26	3840	8760	$180
1-1/2"	25	150	330	31	13980	8760	$654

Table M29-2

Energy Savings = $988.00

Gallons of Hot Water Wated Per Day
Estimated that entire lines are evacuated twice per day
BTU =Gallons x 8.33 x 140°

Pipe Size	Feet of Pipe	Gal. per Ft. of Pipe	Total Gal. per Day	Total Gal. per Year	Total MBTU per Year	Total $ per Year
3/4"	800	0.023	36.8	13432	15.66	$84
1"	180	0.04	14.4	5256	6.13	$33
1-1/4"	90	0.063	11.34	4139	4.83	$26
1-1/2"	355	0.102	72.42	26433	30.82	$165

Table M29-3

Energy Savings = $308.00

Total Energy Savings = $1,296

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM29
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	19599.
B. SIOH	$	1176.
C. DESIGN COST	$	1078.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	19668.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	19668.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	243.	$ 991.	11.67	11565.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		243.	$ 991.		$ 11565.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3816.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 991.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 11565.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.59
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 19.85

CONSTRUCTION COST ESTIMATE		DATE PREPARED Mar-90		SHEET OF 1
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE		
LOCATION FORT LEAVENWORTH, KS		__X__ CODE A (NO DESIGN COMPLETED)		
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		____ CODE B (PRELIMINARY DESIGN) ____ CODE C (FINAL DESIGN) ____ OTHER (SPECIFY)		
DRAWING NO. NONE	ESTIMATOR RGB		CHECKED BY MAW	

STEAM TO HOT WATER HEAT EXCHANGES AND INSTANTANEOUS ELECTRIC HOT WATER HEATERS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 450							
INSTANTANEOUS HOT WATER HEATER	4	EA	$145	$580	$120	$480	$1,060
BUILDING 463							
INSTANTANEOUS HOT WATER HEATER	5	EA	$145	$725	$120	$600	$1,325
BUILDING 464							
STEAM TO HOT WATER HEAT EXCHANGER	1	EA	$1,100	$1,100	$168	$168	$1,268
CONTROL VALVES, THERMOMETER, ECT.	1	EA	$670	$670	$240	$240	$910
BUILDING 466							
STEAM TO HOT WATER HEAT EXCHANGER	1	EA	$2,150	$2,150	$670	$670	$2,820
CONTROL VALVES, THERMOMETER, ECT.	1	EA	$890	$890	$310	$310	$1,200
BUILDING 467							
INSTANTANEOUS HOT WATER HEATER	2	EA	$145	$290	$120	$240	$530
BUILDING 468							
STEAM TO HOT WATER HEAT EXCHANGER	1	EA	$700	$700	$134	$134	$834
CONTROL VALVES, THERMOMETER, ECT.	1	EA	$520	$520	$260	$260	$780
BUILDING 472							
INSTANTANEOUS HOT WATER HEATER	5	EA	$145	$725	$120	$600	$1,325
BUILDING 473							
INSTANTANEOUS HOT WATER HEATER	5	EA	$145	$725	$120	$600	$1,325
SUBTOTAL				$9,075		$4,302	$13,377
CONTINGENCY 10%			10%	$908	10%	$430	$1,338
SUBTOTAL				$9,983		$4,732	$14,715
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$349	13.0%	$615	$964
DIRECT COST				$10,332		$5,347	$15,679
OVERHEAD AND PROFIT			25%	$2,583	25%	$1,337	$3,920
SUBTOTAL				$12,915		$6,684	$19,599
CONSTRUCTION COST							**$19,599**

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

ECO-M30

DOMESTIC WATER PIPE INSULATION

DOMESTIC WATER PIPE INSULATION

ENERGY CONSERVATION OPPORTUNITY: ECO-M30

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M30) analyzes the energy savings associated with reducing the amount of heat transfer through the walls of domestic hot water piping. Domestic hot water piping can lose heat to its surroundings because of a temperature difference between the water and the ambient space temperature through which it is routed. A reduction in the hot water temperature at the point of use will cause an increase in hot water usage thus causing an increase in energy.

SCOPE:

The implementation of this ECO-M6 simulation includes all piping that exists without insulation and is exposed to unconditioned spaces. The piping considered in this ECO is located in the Castle and in the pipe tunnels connecting the building around the South Gate. Hot water piping contained inside the rest of the buildings considered in this study is located in concealed chases which are not accessible for insulating.

MODELING TECHNIQUES:

The modeling techniques used to calculate the energy savings associated with the addition of pipe insulation was figured on a savings per foot of pipe. Tables M30-1 and M30-2 give the BTUH per lineal foot heat loss through bare and insulated pipe. The existing hot water temperature of 185° was used along with an ambient space temperature of 68°. Table M30-3 gives the energy savings and the installed cost of the insulation on a lineal foot bases. A visual inspection was done to estimate the percentage of domestic hot water piping that was uninsulated.

ECO IMPLEMENTATION:

To implement this ECO for the buildings listed above, the existing uninsulated pipe would have to be insulated using 1/2" fiberglass pipe insulation. A difficulty factor of 2 was added to the labor cost because of the confined areas at which the hot water piping is located.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table M30.1 in million BTU's savings as determined using the computer simulation model.

The probable construction cost to implement this ECO by building is shown in Table M30.1. This project cost is the construction cost plus 6% SIOH.

Building Number	Energy Savings (BTUH)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
Castle Buildings	147	$787	$1,447	2.28	5.11
Pipe Tunnels	55	$293	$481	2.03	5.75

Table M30.1

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 2
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M30	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Table was developed from fig. 44 of the Guidlines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
Domestic Hot Water Temperature 180°

Pipe Size	BTUH Loss Bare Pipe	BTUH Loss Insulated	BTUH Savings	Hours per Year	$ Savings per L.F.
3/4"	85	19	66	4380	$1.54
1"	105	23	82	4380	$1.92
1-1/4"	126	26	100	4380	$2.34
1-1/2"	150	31	119	4380	$2.78
2"	171	37	134	4380	$3.13
2-1/2"	250	45	205	4380	$4.79

CALCULATION SHEET		DATE Mar-90	SHEET OF 2 2
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M30	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
REF: Guidlines for Saving Energy in Existing Buildings
Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
Length of pipe estimated from field inspection and plans.

Castle Buildings

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	$ Savings Year
3/4"	80	$1.54	$123
1"		$1.92	$0
1-1/4"	260	$2.34	$608
1-1/2"	20	$2.78	$56
2"		$3.13	$0

Energy Savings = **$787.00**

Pipe Tunnels

Pipe Size	Feet of Bare Pipe	$ Savings per Ft.	$ Savings Year
3/4"		$1.54	$0
1"		$1.92	$0
1-1/4"	60	$2.34	$140
1-1/2"	55	$2.78	$153
2"		$3.13	$0

Energy Savings = **$293.00**

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM30CB
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	1365.
B. SIOH	$	82.
C. DESIGN COST	$	75.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	1370.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	1370.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	147.	$ 600.	11.67	7002.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		147.	$ 600.		$ 7002.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 2311.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 600.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 7002.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 5.11
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.28

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM30PT
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	454.
B. SIOH	$	27.
C. DESIGN COST	$	25.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	455.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	455.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	0.	$ 0.	8.69	0.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	55.	$ 224.	11.67	2614.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		55.	$ 224.		$ 2614.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 863.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 224.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2614.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 5.75
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.03

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 1 OF

PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)
	CODE C (FINAL DESIGN)
	OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
Castle Buildings	R.G.B.	M.A.W.

1/2" FIBERGLASS PIPE INSULATION W/ ALL SERVICE JACKET	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
3/4" PIPE	80	L. F.	$0.87	$69.60	$1.44	$115.20	$184.80
1-1/4" PIPE	260	L. F.	$1.01	$262.60	$1.57	$408.20	$670.80
1-1/2" PIPE	20	L. F.	$1.10	$22.00	$1.57	$31.40	$53.40
SUBTOTAL				$354		$555	$909
CONTINGENCY 10%			$0.10	$35	10%	$55	$90
SUBTOTAL				$389		$610	$999
WORK COMP,TAX,SOC.SEC.,INS			$0.04	$14	13.0%	$79	$93
DIRECT COST				$403		$689	$1,092
OVERHEAD AND PROFIT			$0.25	$101	25%	$172	$273
SUBTOTAL				$504		$861	$1,365
CONSTRUCTION COST							$1,365

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF 2

PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KS	__X__ **CODE A (NO DESIGN COMPLETED)**
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP	____ CODE B (PRELIMINARY DESIGN) ____ CODE C (FINAL DESIGN) ____ OTHER (SPECIFY)

DRAWING NO. Pipe Tunnels	ESTIMATOR R.G.B.	CHECKED BY M.A.W.

1/2" FIBERGLASS PIPE INSULATION W/ ALL SERVICE JACKET	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
1-1/4" PIPE	60	L. F.	$1.01	$60.60	$1.57	$94.20	$154.80
1-1/2" PIPE	55	L. F.	$1.10	$60.50	$1.57	$86.35	$146.85
SUBTOTAL				$121		$181	$302
CONTINGENCY 10%			$0.10	$12	10%	$18	$30
SUBTOTAL				$133		$199	$332
WORK COMP,TAX,SOC.SEC.,INS			$0.04	$5	13.0%	$26	$31
DIRECT COST				$138		$225	$363
OVERHEAD AND PROFIT			$0.25	$35	25%	$56	$91
SUBTOTAL				$173		$281	$454
CONSTRUCTION COST							$454

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

ECO-M31

HEAT RECOVERY FOR LAUNDRY

HEAT RECOVERY FOR LAUNDRY

ENERGY CONSERVATION OPPORTUNITY: ECO-M31

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M31) analyzes energy savings possibilities from heat recovery from equipment in the laundry facility at the USDB. Because the laundry facility is beingrelocated, we are only making general recommendations based on the most up-to-date information available for laundry equipment in the USDB at this time.

SCOPE:

The ECO simulation (ECO-M31) investigates possibilities for heat recovery from laundry wash water, dryers, and irons (presses). Heat recovery applications in similar laundry facilities will be investigated and their feasibility at the USDB will be discussed.

Laundry wash water heat may be recovered in two ways; either by recycling dirty wash water and attempting to clean it by mechanical and chemical means or by using a system designed for recovering heat only (not water).

Disadvantages to recycling dirty wash water are that they require complicated hardware and expensive chemicals. High initial cost, high operating costs, and more maintenance problems rule this out as a possibility.

Heat reclamation systems, however, are simpler to install, operate, and maintain because they have fewer mechanical components and controls (see Fig. 1). Spent hot wash water is dumped first to a channel leading to a sump pit. Before it reaches the pit, it passes through a series of screens to remove lint and other solids. The dirty water is then pumped from the sump into the shell of a heat exchanger where it passes over a series of helical coil heat exchangers. Fresh (cold) water inside the coils passes in the opposite direction. Typically, dirty hot water enters the shell of the heat exchanger at 135° F and exits at 85° F while cold fresh water enters the heat exchanger at 60° F and exits at 110° F. This preheated fresh water then enters a water heater where it is brought up to 180° F and stored in a stratified storage tank for use upon demand. Some designs facilitate the washdown of heat exchanger coils without the need for disassembly of the unit. Typically, these units are installed in concrete troughs to permit washdown of the coils in place. These cleanings, which normally take less than 15 minutes, require no tools and are typically done weekly.

Heat recovery from dryer exhaust can be accomplished by means of air-to-air heat exchangers. Hot, lint-laden air exhausted from the dryers would enter a counterflow heat exchanger on one side while cooler outside air enters from the opposite side.

This supply would then be used as preheated make-up air for the dryers. Plates in the heat transfer matrix separate the two air streams and act as a heat transfer surface. The main problems inherent in systems such as this are related to lint and moisture in the air. However, these problems are addressed by careful selection of heat exchanger materials and adequate plate spacing.

Heat recovery from the nine dryers in the USDB laundry could best be done, but at a prohibitive cost, by nine heat recovery units (HRU's) which would only operate when their respective dryer was running. This would maximize the utilization of waste heat, taking it only from an active dryer and transferring it to make-up air for that same dryer. On the other hand, a central heat recovery unit (see Fig. 2) serving all nine dryers would be removing and supplying air at a constant rate, so that if some dryers are not operating, lower exhaust temperatures would reduce the amount of waste (and recoverable) heat.available. The ideal arrangement of dryers for a central HRU would be side-by side, against a wall with an insulated plenum space and room for exhaust ductwork inside. Make-up air preheated by the HRU would be dumped into the plenum for direct use by the dryers. This type of layout would be much better than dumping make-up air into the occupied space during the heating season, because it could be used year-round and it more efficiently utilizes the heat recovered. For this reason, we recommend that special consideration is given to layout of the dryers if this ECO is to be implemented.

Heat recovery from steam irons/presses is not a valid consideration. They do not waste enough heat in a form that is easily recovered. Their function is to apply heat, moisture, and pressure directly to pieces of laundry. Because this process transfers heat efficiently and without much waste, there is no opportunity for heat recovery here.

MODELING TECHNIQUES:

Energy savings associated with implementation of this ECO were calculated using performance data from manufacturers of helical coil heat exchangers and air-to air heat recovery units.

ECO IMPLEMENTATION:

The best opportunity for implementation of this ECO would be when the laundry facility reaches a permanent location. This way, heat recovery systems can be incorporated into the design more readily than trying to incorporate them into an existing facility.

This implementation would include installation of a wastewater heat recovery system, a new semi-instantaneous water heater, and the associated pumps, piping, and accessories required for proper operation of the system. If dryer heat recovery is to be implemented, installation of an 18,000 cfm air-to-air heat recovery unit, and associated controls, ductwork and accessories would be required.

SUMMARY:

The project cost is the construction cost, plus 6% SIOH. Wastewater heat recovery and dryer exhaust heat recovery were considered as separate projects.

The energy savings associated with the implementation of this ECO by project is also shown in Table M31-1 in MBTU's per year savings as determined by hand calculations.

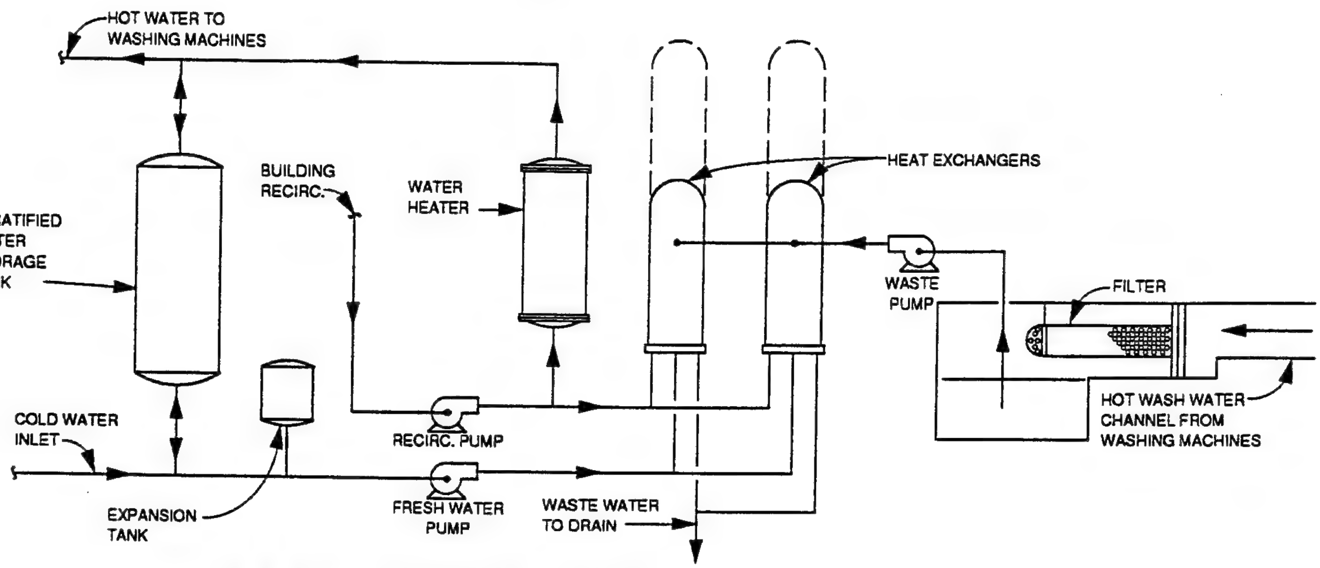
The simple payback for both ECO projects is shown in Table M31-1.

The savings to investment ratio (SIR) for both ECO projects is shown in Table M31-1.

We recommend wash water heat recovery, but dryer exhaust heat recovery is not as feasible. High first cost and space constraints make it a less attractive alternative.

Project	Gas Energy Savings (MBTU/yr.)	Electric Energy Savings (MBTU/yr.)	Cost Savings ($/yr.)	Project Cost ($)	Simple Payback (years)	Savings to Invest Ratio
Wash water H.R.	3,878	-6.43	15,742	43,829	2.78	4.18
Dryer Exhaust H.R	2,821	-73.5	10,597	111,688	10.54	1.13

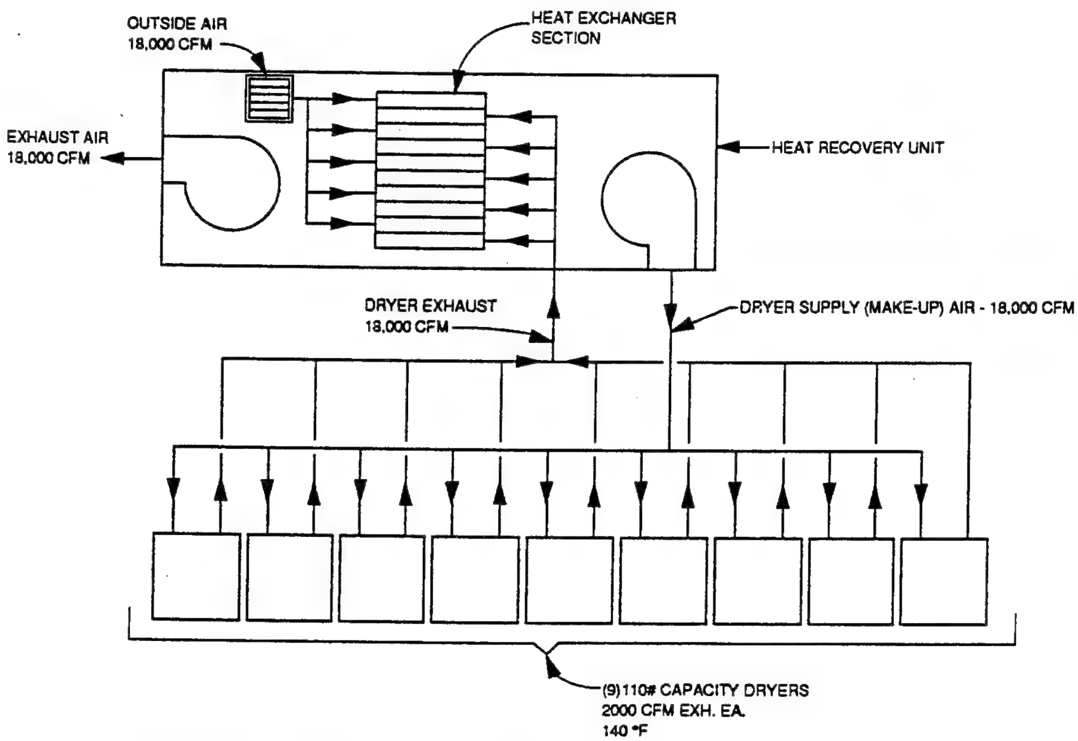
Table M31-1



WASH WATER HEAT RECOVERY SCHEMATIC

NOT TO SCALE

Fig. 1



DRYER EXHAUST HEAT RECOVERY SCHEMATIC

NOT TO SCALE

Fig. 2

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION	FORT LEAVENWORTH, KANSAS	X HAND	
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP	___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ECO MEASURE	ECO-M31 WASH WATER HEAT RECOVERY	COMPUTED BY BMS	CHECKED BY MAW

GIVEN:

HOT WATER USE TEMP., °F	160
AVERAGE COLD WATER INLET TEMPERATURE, °F	50
GALLONS WATER/LB. OF LAUNDRY	2.5
PERCENT OF WASTE WATER THAT IS HOT	70
HOURS OF OPERATION PER WEEK	40
ELECTRICITY COST, DOLLARS/MBTU	12.44
GAS COST IN DOLLARS/MBTU	4.08
BOILER SEASONAL EFFICIENCY, %	74

CALCULATED WASTE WATER TEMP., °F	127
WASTE WATER TEMP USED IN ANALYSIS, °F	124

BASED ON HEAT EXCHANGER MANUFACTURER'S PERFORMANCE DATA FOR 30 GPM UNIT:

SHELL SIDE TEMPERATURE, °F IN/OUT	124 / 91
TUBE SIDE TEMPERATURE, °F IN/OUT	50 / 96

STEAM HEAT RECOVERED, MBTU/YR:	2,870
GAS HEAT RECOVERED, MBTU/YR:	3,878

(2) 30 GPM UNITS ARE REQUIRED.

PUMP ENERGY CALCULATION FOR THIS ECO

FRESH WATER PUMP CAPACITY, GPM:	60
FRESH WATER PUMP HEAD, FT. W:	38
FRESH WATER PUMP EFFICIENCY, %:	65
WASTE WATER PUMP CAPACITY, GPM:	84
WASTE WATER PUMP HEAD, FT. W:	10
WASTE WATER PUMP EFFICIENCY, %:	65
FRESH WATER PUMP POWER CONSUMPTION, WATTS:	662
FRESH WATER PUMP ENERGY USE, MBTU/YEAR:	4.70
WASTE WATER PUMP POWER CONSUMPTION, WATTS:	244
WASTE WATER PUMP ENERGY USE, MBTU/YEAR:	1.73
TOTAL PUMP ENERGY, MBTU/YR.:	6.43

NET ENERGY SAVINGS FOR WASH WATER H.R., MBTU/YR.: 3,872

NET ENERGY SAVINGS, $/YR: 15,742

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 2
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
LOCATION	FORT LEAVENWORTH, KANSAS		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M31 DRYER EXHAUST HEAT RECOVERY	COMPUTED BY BMS	CHECKED BY MAW

AIR-TO-AIR HEAT RECOVERY UNIT PERFORMANCE DATA:

SUMMER (EFFECTIVENESS = 57.95%)

SUPPLY SIDE:		EXHAUST SIDE:	
INLET TEMPERATURE (°F) =	95	INLET TEMPERATURE (°F) =	140
OUTLET TEMPERATURE (°F) =	121.07	OUTLET TEMPERATURE (°F) =	114.12
CFM =	18,000	CFM =	18,000
W (LB. W./LB. D.A.) =	0.0168	W (LB. W./LB. D.A.) =	0.0398
ΔP (IN. W.G.) =	0.99	ΔP (IN. W.G.) =	1.01

WINTER (EFFECTIVENESS = 65.36%)

SUPPLY SIDE:		EXHAUST SIDE:	
INLET TEMPERATURE (°F) =	0	INLET TEMPERATURE (°F) =	140
OUTLET TEMPERATURE (°F) =	91.5	OUTLET TEMPERATURE (°F) =	89.55
CFM =	18000	CFM =	18000
W (LB. W./LB. D.A.) =	0.0001	INLET W (LB. W./LB. D.A.) =	0.0398
ΔP (IN. W.G.) =	0.87	OUTLET W (LB. W./LB. D.A.) =	0.0306
		ΔP (IN. W.G.) =	0.97
		WATER CONDENSED (LB./HR.)	699

ASSUMPTIONS MADE FOR YEAR-ROUND HEAT RECOVERY BIN ANALYSIS

1) AMOUNT OF WATER CONDENSED FROM DRYER EXHAUST VS. OUTDOOR AIR DRY-BULB TEMPERATURE IS A LINEAR RELATIONSHIP.
2)HEAT EXCHANGER EFFECTIVEDNESS VS. OUTDOOR AIR DRY-BULB TEMPERATURE IS A LINEAR RELATIONSHIP.

THEREFORE:

$\Delta Q = E \times 1.08 \times 18000 \times (140 - T_{c,i})$

WHERE:
ΔQ = HEAT TRANSFERRED BETWEEN AIR STREAMS
E = EFFECTIVENESS
$= .6536 - (T_{c,i}/95) \times (.6536 - .5795)$
$T_{c,i}$ = OUTSIDE AIR DRY-BULB TEMPERATURE

THIS FORM ULA WAS USED TO CALCULATE HEAT RECOVERY IN THE BIN ANALYSIS ON THE NEXT PAGE.

CALCULATION SHEET	DATE Mar-90	SHEET 2 OF 2
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KANSAS	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-M31 DRYER EXHAUST HEAT RECOVERY	COMPUTED BY BMS	CHECKED BY MAW

DRYER HEAT RECOVERY ANALYSIS USING ASHRAE MODIFIED BIN METHOD

TEMP. BIN	AVG. DB TEMP	BIN HOURS/YEAR 01 TO 08	09 TO 16	05:30 TO 13:30	STEAM MBTU'S RECOV.
105/109	107	0	3	1	0.37
100/104	102	0	15	7	2.97
95/99	97	0	51	25	12.08
90/94	92	1	127	62	33.66
85/89	87	6	203	101	60.95
80/84	82	56	265	142	94.41
75/79	77	162	262	165	119.94
70/74	72	257	236	173	136.63
65/69	67	274	209	164	139.95
60/64	62	264	195	154	141.33
55/59	57	230	190	144	141.53
50/54	52	197	185	135	141.58
45/49	47	181	177	127	141.65
40/44	42	188	169	125	147.85
35/39	37	226	175	136	170.13
30/34	32	248	151	129	170.26
25/29	27	214	113	103	143.12
20/24	22	150	76	71	103.66
15/19	17	103	52	48	73.49
10/14	12	67	33	31	49.70
5/9	7	50	20	21	35.19
0/4	2	23	8	9	15.74
-5/-1	-3	14	3	5	9.12
-10/-6	-8	4	0	1	1.90
-15/-11	-13	1	0	0	0.00
TOTALS		2916	2918	2079	2087

BOILER SEASONAL EFFICIENCY: 74%
GAS COST, $/MBTU: 4.08
TOTAL ANNUAL GAS SAVINGS, MBTU: 2820
ELECTRICITY COST, $/MBTU: 12.44
FAN AIR HORSEPOWER ADDED: 13.9
ANNUAL FAN ENERGY CONSUMPTION, MBTU: 73.5

TOTAL ESTIMATED ANNUAL SAVINGS, $ = 10,591

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM31W
ANALYSIS DATE: 03-27-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

1. INVESTMENT

A. CONSTRUCTION COST	$	43829.
B. SIOH	$	2630.
C. DESIGN COST	$	2411.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	43983.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	43983.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	-6.	$	-75.	8.69		-652.
B. DIST	$	.00	0.	$	0.	12.42		0.
C. RESID	$	.00	0.	$	0.	12.21		0.
D. NAT G	$	4.08	3878.	$	15822.	11.67		184643.
E. COAL	$	.00	0.	$	0.	10.36		0.
F. TOTAL			3872.	$	15747.		$	183991.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 60717.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 15747.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 183991.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 4.18
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.79

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOM31D
ANALYSIS DATE: 03-27-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	111688.
B. SIOH	$	6701.
C. DESIGN COST	$	6143.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	112079.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	112079.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	-74.	$ -921.	8.69	-8003.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	2821.	$ 11510.	11.67	134322.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		2747.	$ 10589.		$ 126319.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 41685.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 10589.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 126319.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.13
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 10.58

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET OF 1
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: BMS	CHECKED BY: MAW

ECO-M31	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
WASH WATER HEAT RECOVERY SYSTEM							
HELICAL COIL HEAT EXCHANGER	2	EA	$9,500	$19,000	$1,010	$2,020	$21,020
FRESH WATER PUMP (59 GPM, 50 FT. HD.)	1	EA	$1,070	$1,070	$180	$180	$1,250
WASTE WATER PUMP (94 GPM, 10 FT. HD.)	1	EA	$500	$500	$40	$40	$540
STRATIFIED WATER STORAGE TANK	1	EA	$6,500	$6,500	$355	$355	$6,855
2" SCHEDULE 40 STEEL PIPING & ACCESSORIES	100	LF	$3	$289	$6	$555	$844
SUBTOTAL				$27,359		$3,150	$30,509
CONTINGENCY 10%			10%	$2,736	10%	$315	$3,051
SUBTOTAL				$30,095		$3,465	$33,560
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$1,053	13.0%	$450	$1,503
DIRECT COST				$31,148		$3,915	$35,063
OVERHEAD AND PROFIT			25%	$7,787	25%	$979	$8,766
SUBTOTAL				$38,935		$4,894	$43,829
CONSTRUCTION COST							$43,829

ENG. FORM 150
1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET OF 2
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: BMS	CHECKED BY: MAW

ECO-M31	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
DRYER EXHAUST HEAT RECOVERY SYSTEM							
18,000 CFM HEAT RECOVERY UNIT & CONTROLS	1	EA	$71,220	$71,220	$4,280	$4,280	$75,500
DUCTWORK & ACCESSORIES	825	LB	$1	$652	$2	$1,774	$2,426
SUBTOTAL				$71,872		$6,054	$77,926
CONTINGENCY 10%			10%	$7,187	10%	$605	$7,792
SUBTOTAL				$79,059		$6,659	$85,718
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$2,767	13.0%	$866	$3,633
DIRECT COST				$81,826		$7,525	$89,351
OVERHEAD AND PROFIT			25%	$20,456	25%	$1,881	$22,337
SUBTOTAL				$102,282		$9,406	$111,688
CONSTRUCTION COST							$111,688

ENG. FORM 150
1AVC-59

ECO-M39

WATER HEATING HEAT PUMPS

WATER HEATING HEATPUMPS

ENERGY CONSERVATION OPPORTUNITY: ECO-M39

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M39) analyzes the energy savings associated with installing water heating heatpumps to condition the interior spaces.

SCOPE:

The ECO simulation (ECO-M39) replaces any space conditioning equipement with water source heatpumps. The replacement of space conditioning equipment can be completed in any of the buildings being considered that meet interior space conditions. The application of this ECO was considered for all of the buildings that presently have cooling in the spaces:

Building 450
Building 463
Building 464
Building 465
Building 472

Building 473
Building 475A
Building 475B
Building 475H

MODELING TECHNIQUES:

The modeling technique used to calculated the energy savings for this ECO was calculated using hand calculations. The efficiencies of the existing systems can be determined from the computer simulation printouts. Table M39.1 gives the existing heating and cooling systems efficiencies versus the heatpump system efficiencies. The data for the heatpump efficiencies was determined from a heatpump installation study[3] that was considered similar in capacity to the buildings in the USDB.

Building Number	Existing Cooling Efficiency (KWh/Ton)	Existing Heating Efficiency (thrm/Btuh)	Heatpump Cooling Efficiency (KWh/Ton)	Heatpump Heating Efficiency (thrm/thrm)
450	1.30	0.85	1.1	0.85
463	1.35	0.83	1.1	0.85
464	1.35	0.83	1.1	0.85
465	1.45	0.78	1.1	0.85
472	1.30	0.77	1.1	0.85
473	1.35	0.83	1.1	0.85
475A	1.48	0.85	1.1	0.85
475B	1.48	0.85	1.1	0.85
475H	1.48	0.85	1.1	0.85

Table M39.1

With the known yearly heating and cooling load from the computer simulations, a yearly energy savings was determined in Table M39.2. Table M39.3 displays the total energy savings in MBTU and the cost savings in dollars.

Building Number	Existing Cooling Energy (KWh/yr)	Existing Heating Energy (thrm/yr)	Heatpump Cooling Energy (KWh/yr)	Heatpump Heating Energy (thrm/yr)
450	17,892	3,629	15,139	3,629
463	11,514	1,577	9,382	1,540
464	18,063	2,195	14,718	2,143
465	12,914	35,995	9,797	33,031
472	38,980	15,515	32,983	14,054
473	26,906	2,407	21,923	2,407
475A	22,868	12,773	16,996	12,773
475B	14,139	8,477	10,509	8,477
475H	10,589	8,137	7,870	8,137

Table M39.2

ECO IMPLEMENTATION:

To implement this ECO, a considerable amount of mechanical demolition and new retrofit is necessary. Some of the buildings have existing piping to areas for heatpumps which can be utilized for the condenser water. In this case the installation

of the heatpumps is average. In other buildings, the means of cooling in done by package window air conditioners. In these cases, the piping for the condenser water loop will be installed for each heatpump location. A heatpump would be installed in every location of the window air conditioner.

SUMMARY:

The energy savings associated with the implementation of this ECO by building is shown below in Table M39.3 in million BTU's per year savings as determined in the calculation section of this section.

The project cost is the construction cost as determined in the cost estimate plus 6% SIOH.

Building Number	Energy Savings (MBTU)	Cost Savings	Project Cost	Simple Payback	Savings to Invest Ratio
450	9	$117	$77,691	656.70	0.01
463	11	$106	$56,779	521.87	0.02
464	16	$163	$63,266	34.46	0.34
465	307	$1,342	$41,353	29.11	0.39
472	166	$851	$169,273	189.65	0.06
473	17	$212	$91,436	410.25	0.02
475A	20	$249	$103,019	391.68	0.02
475B	12	$154	$64,902	412.37	0.02
475H	9	$115	49,791	420.35	0.02

Table M39.3

None of the buildings considered for this ECO show a payback that is feasible for implementing the ECO. One of the reasons for not showing a good payback, is that the condenser water that is used to loop through the heatpumps is not available and a fluid cooler or water tower has to be installed. The project cost is very high for this ECO because of the conditions of the work areas and that some piping for the buildings has to be installed. To make the payback even less favorable, the heatpumps have a higher maintenance cost than the existing equipment.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 450M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	73293.
B. SIOH	$	4398.
C. DESIGN COST	$	4031.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	73550.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	73550.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	9.	$ 112.	8.69	973.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		9.	$ 112.		$ 973.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 321.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 112.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 973.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.01
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 656.70

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 463M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	53565.
B. SIOH	$	3214.
C. DESIGN COST	$	2946.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	53753.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	53753.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	7.	$	87.	8.69		756.
B. DIST	$	.00	0.	$	0.	12.42		0.
C. RESID	$	.00	0.	$	0.	12.21		0.
D. NAT G	$	4.08	4.	$	16.	11.67		187.
E. COAL	$	.00	0.	$	0.	10.36		0.
F. TOTAL			11.	$	103.		$	943.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 311.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS => 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 103.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 943.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.02
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 521.87

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 464M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	59685.
B. SIOH	$	3581.
C. DESIGN COST	$	3283.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	59894.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	59894.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 2.00	11.	$ 22.	8.69	191.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 343.24	5.	$ 1716.	11.67	20026.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		16.	$ 1738.		$ 20217.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 6672.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1738.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 20217.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.34
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 34.46

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 465M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	39012.
B. SIOH	$	2341.
C. DESIGN COST	$	2146.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	39149.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	39149.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	11.	$ 137.	8.69	1191.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	296.	$ 1208.	11.67	14097.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		307.	$ 1345.		$ 15288.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 5045.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 1345.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 15288.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.39
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 29.11

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 472M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	159692.
B. SIOH	$	9582.
C. DESIGN COST	$	8783.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	160251.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	160251.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	20.	$ 249.	8.69	2164.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	146.	$ 596.	11.67	6955.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		166.	$ 845.		$ 9119.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 3009.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 845.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 9119.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.06
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 189.65

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 473M39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	86261.
B. SIOH	$	5176.
C. DESIGN COST	$	4744.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	86563.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	86563.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	17.	$ 211.	8.69	1834.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		17.	$ 211.		$ 1834.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 605.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 211.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1834.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.02
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 410.25

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475AM39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	97188.
B. SIOH	$	5831.
C. DESIGN COST	$	5345.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	97528.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	97528.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	20.	$ 249.	8.69	2164.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		20.	$ 249.		$ 2164.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 714.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 249.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2164.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.02
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 391.68

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475BM39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	61228.
B. SIOH	$	3674.
C. DESIGN COST	$	3368.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	61443.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	61443.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	12.	$ 149.	8.69	1295.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		12.	$ 149.		$ 1295.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 427.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 149.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1295.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.02
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 412.37

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: 475HM39
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	46915.
B. SIOH	$	2815.
C. DESIGN COST	$	2580.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	47079.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	47079.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	9.	$ 112.	8.69	973.
B. DIST	$ .00	0.	$ 0.	12.42	0.
C. RESID	$ .00	0.	$ 0.	12.21	0.
D. NAT G	$ 4.08	0.	$ 0.	11.67	0.
E. COAL	$ .00	0.	$ 0.	10.36	0.
F. TOTAL		9.	$ 112.		$ 973.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 9.11
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 321.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 112.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 973.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 0.02
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 420.35

CONSTRUCTION COST ESTIMATE		DATE PREPARED 4/2/90	SHEET 1 OF 9
PROJECT USDB ENERGY STUDY		BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS		X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		CODE B (PRELIMINARY DESIGN)	
		CODE C (FINAL DESIGN)	
		OTHER (SPECIFY)	
DRAWING NO. NONE	ESTIMATOR MJM	CHECKED BY MAW	

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 450 , 32 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF BUILDING, PUMP IN EXISTING							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	9200	SQFT	$3	$23,276	$2	$14,352	$37,628
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	9200	SQFT			$1	$11,500	$11,500
SUBTOTAL				$23,276		$25,852	$49,128
CONTINGENCY 10%			10%	$2,328	10%	$2,585	$4,913
SUBTOTAL				$25,604		$28,437	$54,041
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$896	13.0%	$3,697	$4,593
DIRECT COST				$26,500		$32,134	$58,634
OVERHEAD AND PROFIT			25%	$6,625	25%	$8,034	$14,659
SUBTOTAL				$33,125		$40,168	$73,293
CONSTRUCTION COST							$73,293

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 2 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 463 , 22 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF BUILDING, PUMP IN EXISTING							
HEAT EXCHANGER ROOM, COST ON A							
SQUARE FOOT BASIS.	7700	SQFT	$3	$19,481	$2	$12,012	$31,493
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	7700	SQFT			$1	$4,620	$4,620
SUBTOTAL				$19,481		$16,632	$36,113
CONTINGENCY 10%			10%	$1,948	10%	$1,663	$3,611
SUBTOTAL				$21,429		$18,295	$39,724
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$750	13.0%	$2,378	$3,128
DIRECT COST				$22,179		$20,673	$42,852
OVERHEAD AND PROFIT			25%	$5,545	25%	$5,168	$10,713
SUBTOTAL				$27,724		$25,841	$53,565
CONSTRUCTION COST							$53,565

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 3 OF 9
PROJECT USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
DRAWING NO. NONE	ESTIMATOR MJM	CHECKED BY MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 464 , 26 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF BUILDING, PUMP IN EXISTING							
FIRST FLOOR CLOSET, COST ON A							
SQUARE FOOT BASIS.	6700	SQFT	$3	$22,043	$2	$14,204	$36,247
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	6700	SQFT			$1	$4,020	$4,020
SUBTOTAL				$22,043		$18,224	$40,267
CONTINGENCY 10%			10%	$2,204	10%	$1,822	$4,026
SUBTOTAL				$24,247		$20,046	$44,293
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$849	13.0%	$2,606	$3,455
DIRECT COST				$25,096		$22,652	$47,748
OVERHEAD AND PROFIT			25%	$6,274	25%	$5,663	$11,937
SUBTOTAL				$31,370		$28,315	$59,685
CONSTRUCTION COST							$59,685

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 4 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 465 , 17 TONS OF COOLING,							
FLUID COOLER LOCATED ON WEST SIDE							
OF BUILDING, PUMP IN EXISTING							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	4897	SQFT	$3	$12,389	$2	$7,639	$20,029
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	4897	SQFT			$1	$6,121	$6,121
SUBTOTAL				$12,389		$13,761	$26,150
CONTINGENCY 10%			10%	$1,239	10%	$1,376	$2,615
SUBTOTAL				$13,628		$15,137	$28,765
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$477	13.0%	$1,968	$2,445
DIRECT COST				$14,105		$17,105	$31,210
OVERHEAD AND PROFIT			25%	$3,526	25%	$4,276	$7,802
SUBTOTAL				$17,631		$21,381	$39,012
CONSTRUCTION COST							$39,012

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 5 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 472 , 69 TONS OF COOLING,							
FLUID COOLER LOCATED ON SOUTH SIDE							
OF BUILDING, PUMP IN EXISTING							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	19300	SQFT	$3	$58,479	$2	$37,635	$96,114
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	19300	SQFT			$1	$11,580	$11,580
SUBTOTAL				$58,479		$49,215	$107,694
CONTINGENCY 10%			10%	$5,848	10%	$4,922	$10,770
SUBTOTAL				$64,327		$54,137	$118,464
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$2,251	13.0%	$7,038	$9,289
DIRECT COST				$66,578		$61,175	$127,753
OVERHEAD AND PROFIT			25%	$16,645	25%	$15,294	$31,939
SUBTOTAL				$83,223		$76,469	$159,692
CONSTRUCTION COST							$159,692

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PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 6 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 473 , 39 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF BUILDING, PUMP IN BLDG 463							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	12400	SQFT	$3	$31,372	$2	$19,344	$50,716
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	12400	SQFT			$1	$7,440	$7,440
SUBTOTAL				$31,372		$26,784	$58,156
CONTINGENCY 10%			10%	$3,137	10%	$2,678	$5,815
SUBTOTAL				$34,509		$29,462	$63,971
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$1,208	13.0%	$3,830	$5,038
DIRECT COST				$35,717		$33,292	$69,009
OVERHEAD AND PROFIT			25%	$8,929	25%	$8,323	$17,252
SUBTOTAL				$44,646		$41,615	$86,261
CONSTRUCTION COST							$86,261

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1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 7 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475A , 39 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF CASTLE, PUMP IN ROTUNDA							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	11746	SQFT	$3	$35,590	$2	$22,905	$58,495
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	11746	SQFT			$1	$7,048	$7,048
SUBTOTAL				$35,590		$29,952	$65,543
CONTINGENCY 10%			10%	$3,559	10%	$2,995	$6,554
SUBTOTAL				$39,149		$32,947	$72,097
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$1,370	13.0%	$4,283	$5,653
DIRECT COST				$40,519		$37,230	$77,750
OVERHEAD AND PROFIT			25%	$10,130	25%	$9,308	$19,438
SUBTOTAL				$50,649		$46,538	$97,188
CONSTRUCTION COST							$97,188

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1AVC-59

PREVIOUS EDITION MAY BE USED

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 8 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BUILDING 475B, 28 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF CASTLE, PUMP IN ROTUNDA							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	7400	SQFT	$3	$22,422	$2	$14,430	$36,852
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	7400	SQFT			$1	$4,440	$4,440
SUBTOTAL				$22,422		$18,870	$41,292
CONTINGENCY 10%			10%	$2,242	10%	$1,887	$4,129
SUBTOTAL				$24,664		$20,757	$45,421
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$863	13.0%	$2,698	$3,561
DIRECT COST				$25,527		$23,455	$48,982
OVERHEAD AND PROFIT			25%	$6,382	25%	$5,864	$12,246
SUBTOTAL				$31,909		$29,319	$61,228
CONSTRUCTION COST							$61,228

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/2/90	SHEET 9 OF 9
PROJECT: USDB ENERGY STUDY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
DRAWING NO.: NONE	ESTIMATOR: MJM	CHECKED BY: MAW

ECO-M39 WATER HEATING HEATPUMPS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
BUILDING 475H, 20 TONS OF COOLING,							
FLUID COOLER LOCATED ON NORTH SIDE							
OF CASTLE, PUMP IN ROTUNDA							
MECHANICAL ROOM, COST ON A SQUARE							
FOOT BASIS.	6744	SQFT	$3	$17,062	$2	$10,521	$27,583
DEMOLISH EXISTING HVAC EQUIPMENT,							
COST ON A SQUARE FOOT BASIS.	6744	SQFT			$1	$4,046	$4,046
SUBTOTAL				$17,062		$14,567	$31,629
CONTINGENCY 10%			10%	$1,706	10%	$1,457	$3,163
SUBTOTAL				$18,768		$16,024	$34,792
WORK COMP,TAX,SOC.SEC.,INS			3.50%	$657	13.0%	$2,083	$2,740
DIRECT COST				$19,425		$18,107	$37,532
OVERHEAD AND PROFIT			25%	$4,856	25%	$4,527	$9,383
SUBTOTAL				$24,281		$22,634	$46,915
CONSTRUCTION COST							$46,915

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

ECO-E1

LIGHTING LEVELS

LIGHTING LEVELS

ENERGY CONSERVATION OPPORTUNITY: ECO-E1

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-E1) analyzes energy savings associated with lighting level reduction. Project implementation may change existing light fixture layout and new motion detector installation. Project implementation will not affect any high security area light fixtures because of associated high and material labor costs.

SCOPE:

This ECO simulation removes or relocates existing light fixtures and installs motion detectors. The application of this project was considered for the following buildings:

Building	450	Building	473
Building	463	Building	474
Building	464	Building	475A
Building	465	Building	475B
Building	466	Building	475E
Building	472	Building	475H

MODELING TECHNIQUES:

The modeling technique used to justify the existing light fixture removal or modification was the study of lighting energy usage measured in watts per square foot. Army Regulation No. 11-27, Section 3-8b; requires that during working hours, overhead lighting will be reduced to 50 foot-candles at work areas, and 10 or less foot-candles in nonworking areas as prescribed in DOD 4270.1-M. On the average, a lighting level of 50 foot-candles uses about 1.5 watts per square foot. Based on this value, our studies show that USDB lighting levels are in general at or below this level. Original lighting design made extensive use of daylighting and kept artificial lighting to a minimum Therefore, USDB lighting levels cannot be efficiently reduced by removing or modifying existing light fixtures.

Motion sensor installation can be justified in some instances, but lighting use patterns affect potential savings. Some examples of potential savings are shown on page E1-3. The modeling technique for this portion is based on low security fixtures in low security areas. Payback times for fixtures in higher security areas are significantly longer because of higher labor and material costs.

ECO IMPLEMENTATION:

As discussed in the modeling technique section, fixture and lamp removal is not recommended, so no implementation of that option will be discussed.

Motion sensor installation within a space includes the following: demolition of existing switch and associated circuitry; installation of a motion sensor and associated circuitry; and motion sensor calibration. Motion sensors should only be installed after study of lighting use patterns in that space.

SUMMARY:

We believe motion sensors can be installed at a good payback rate in conference-type rooms (may include chapels) where lighting loads are high and where the room may be unoccupied 30% of the time.

Motion sensor installation is not recommended in office spaces because lighting loads are generally low. We do not recommend motion sensor installation in spaces that are considered high security because of higher labor costs associated with those spaces.

Payback calculations for various rooms are shown on page E1-3. Only those rooms with SIR values greater than one are used in life cycle cost analysis.

Sample calculation for typical room installations are shown on page E1-4.

Life cycle cost analysis for this ECO is shown on page E1-5.

CALCULATION SHEET	DATE Mar-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KS	X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-E1	COMPUTED BY DJG	CHECKED BY MAW

BASED ON THE FOLLOWING INFORMATION:
- $200.62 FOR TYPICAL MOTION SENSOR INSTALLATION
- $0.0425 PER KWH ELECTRICITY COST
- 11.16 25-YEAR DISCOUNT FACTOR

BUILDING # AND ROOM TYPE	LIGHTING WATTS	ANNUAL NORMAL HOURS	ANNUAL HOURS SAVED	ANNUAL KWH SAVED	ANNUAL SAVINGS	PAYBACK IN YEARS	SIR
450 CONFERENCE ROOM	1280	2080	624	799	$33.96	5.9	1.9
475A CONFERENCE ROOM	640	2080	624	399	$16.96	11.8	0.9
475A CHAPEL	1620	2080	624	1011	$42.97	4.7	2.4
475E CONFERENCE ROOM	480	2080	624	300	$12.75	15.7	0.7
475B CHAPEL	1500	2080	624	936	$39.78	5.0	2.2
475H CHAPEL	800	2080	624	499	$21.21	9.5	1.2
TOTAL (SIR >1)	5200	2080	624	3245	$137.91	8.7	1.3

CALCULATION SHEET	DATE Mar-90	SHEET 1 OF 1
PROJECT: USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION: FORT LEAVENWORTH, KS	X HAND	
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP	COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ECO MEASURE: ECO-E1	COMPUTED BY DJG	CHECKED BY MAW

AVERAGE PAYBACK TIME FOR REPLACING EXISTING SWITCHES WITH INFRARED MOTION SENSORS FOR VARIOUS SPACES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA
ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS $0.0425 PER KWH

MOTION SENSOR INSTALLATION COST

DEMO EXISTING SWITCH BOX	$2.66
DEMO 8' EMT WITH WIRING	$5.76
INSTALL 20', 3/4" EMT	$53.60
INSTALL 40', #12 CONDUCTORS	$13.60
INSTALL MOTION SENSOR	$125.00
TOTAL COST PER INSTALLATION	$200.62

POSSIBLE ENERGY SAVINGS FOR TYPICAL CONFERENCE ROOM

LIGHTING LOAD	720 WATTS
ANNUAL LIGHTING TIME	3750 HOURS
ANNUAL COST @ $0.0425 PER KWH	$114.75
ANNUAL SAVINGS IF LIGHTS ARE OFF 30% OF TIME	$34.43
COST OF INSTALLATION	$200.62
PAYBACK TIME	5.8 YEARS

POSSIBLE ENERGY SAVINGS FOR TYPICAL SMALL OFFICE ROOM

LIGHTING LOAD	320 WATTS
ANNUAL LIGHTING TIME	3750 HOURS
ANNUAL COST @ $0.0425 PER KWH	$51.00
ANNUAL SAVINGS IF LIGHTS ARE OFF 25% OF TIME	$12.75
COST OF INSTALLATION	$200.62
PAYBACK TIME	15.7 YEARS

NOTE: SAVINGS ARE VERY DEPENDENT ON SEVERAL ITEMS, WHICH INCLUDE THE FOLLOWING:
1) CURRENT PRACTICES IN SWITCHING LIGHTS OFF. IF PEOPLE NORMALLY TURN LIGHTS OFF WHEN NOT IN USE, ENERGY SAVINGS WILL BE MINIMAL.
2) AMOUNT OF TIME THAT LIGHTS WILL NOT BE IN USE. THE ABOVE ESTIMATES MAY VARY AND ACTUAL SAVINGS WILL FLUCTUATE ACCORDINGLY.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOE1
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	802.
B. SIOH	$	48.
C. DESIGN COST	$	44.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	805.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	805.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	11.	$ 137.	11.16	1529.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	0.	$ 0.	16.15	0.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		11.	$ 137.		$ 1529.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 505.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 137.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1529.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.90
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 5.88

ECO-E2

ENERGY EFFICIENT LIGHTING SYSTEMS

ENERGY EFFICIENT LIGHTING SYSTEMS

ENERGY CONSERVATION OPPORTUNITY: ECO-E2

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-E2) analyzes energy savings associated with converting existing lighting systems to energy efficient lighting systems. Project implementation may include component replacement in existing lighting systems to energy efficient units or a complete changeover to more efficient light sources.

SCOPE:

This ECO simulation replaces existing light fixture components with efficient units and replaces inefficient light source systems with efficient light source systems. The application of this project was considered for the following buildings:

Building	450	Building	475A
Building	463	Building	475B
Building	464	Building	475C
Building	465	Building	475D
Building	466	Building	475E
Building	472	Building	475F
Building	473	Building	475G
Building	474	Building	475H
Building	475		

MODELING TECHNIQUES:

The modeling technique used to justify light fixture component replacement was based on the removal of the existing light fixture component and replacement with a more efficient unit. Currently, USDB personnel are replacing 40w fluorescent lamps with 34w fluorescent lamps. Energy savings associated with the lamp change are not totally reallized until the existing ballasts are replaced with energy efficient units.

The modeling technique used to justify light source conversion was based on the removal of the existing incandescent lamp and replacement with a new fluorescent adapter and lamp.

Conversion to HID lamp sources was not investigated due to the extremely high first costs associated with the installation of HID light fixtures.

ECO IMPLEMENTATION:

Option 1: ECO implementation will include ballast and lamp replacement in existing light fixtures with high efficiency units as maintenance requires.

Option 2: Existing incandescent sources will be replaced with fluorescent lamp conversion kits and will be mounted in existing light fixtures.

SUMMARY:

Energy savings due to incandescent/fluorescent light source conversion by building are shown on Table E2.1.

Option 1 probable construction cost has been calculated on page E2-3. Based on these figures, we recommend that existing lighting components be replaced with energy efficient models only as existing components fail. This can be done during regular lighting maintenance by USDB maintenance personnel.

Option 2 probable construction cost has been calculated on page E2-4. Field work indicated that incandescent fixtures are used on a regular basis only in building 475A stairwell. We recommend replacement of these fixtures.

Life cycle costs associated with this ECO are shown on page E2-5.

Building Number	MBTU/Yr. Savings	Energy Savings	Project Cost	Simple Payback	Savings to Invest Ratio
475A	8	$100	$131	1.24	9.00

Table E2.1

CALCULATION SHEET	DATE Mar-90	SHEET 1 OF 1
PROJECT: USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION: X HAND; ___ COMPUTER; ___ CONTRACTOR BID; OTHER (SPECIFY)	
LOCATION: FORT LEAVENWORTH, KS		
ARCHITECT/ENGINEER: CLARK RICHARDSON & BISKUP		
ECO MEASURE: ECO-E2	COMPUTED BY: DJG	CHECKED BY: MAW

AVERAGE PAYBACK TIME FOR RELAMPING AND REBALLASTING FLUORESCENT LIGHT FIXTURES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS $0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 12 HOURS PER DAY = 4380 HOURS PER YEAR

2 LAMP FLUORESCENT LIGHT FIXTURE

COST TO REBALLAST LIGHT FIXTURE		$58.00
COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS	$9.25 x 2 =	$18.50
TOTAL COST PER FIXTURE		$76.50

ELECTRICITY SAVINGS

8W PER LAMP x 2 LAMPS PER FIXTURE = 16W PER FIXTURE PER HOUR

= 0.016 KWH PER FIXTURE

$0.0425 PER KWH x 0.016 KWH x 4380 HRS = $2.98 PER YEAR

SIMPLE PAYBACK

TOTAL COST PER FIXTURE	$76.50
ELECTRICITY SAVINGS PER YEAR	$2.98
SIMPLE PAYBACK IN YEARS	25.7

4 LAMP FLUORESCENT LIGHT FIXTURE

COST TO REBALLAST LIGHT FIXTURE	$58.00 x 2 =	$116.00
COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS	$9.25 x 4 =	$37.00
TOTAL COST PER FIXTURE		$153.00

ELECTRICITY SAVINGS

8W PER LAMP x 4 LAMPS PER FIXTURE = 32W PER FIXTURE PER HOUR

= 0.032 KWH PER FIXTURE

$0.0425 PER KWH x 0.032 KWH x 4380 HRS = $5.97 PER YEAR

SIMPLE PAYBACK

TOTAL COST PER FIXTURE	$153.00
ELECTRICITY SAVINGS PER YEAR	$5.97
SIMPLE PAYBACK IN YEARS	25.6

CALCULATION SHEET	DATE Mar-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KS	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-E2	COMPUTED BY DJG	CHECKED BY MAW

CALCULATIONS FOR RETROFITTING INCANDESCENT FIXTURES TO FLUORESCENT FIXTURES
BUILDING 475A STAIRWELL

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS $0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 24 HOURS PER DAY = 8760 HOURS PER YEAR

DESCRIPTION	NUMBER (EACH)	INSTALLED COST	TOTAL COST	ENERGY USE (W)	TOTAL ENERGY USE
ADAPTER BALLAST	6	$11.00	$66	3	18
13W DOUBLE TWIN TUBE FLUORESCENT LAMP	6	$5.84	$35	13	78
LABOR	6	$3.75	$23	0	0
TOTAL			$124		0.096KW

EXISTING ELECTRICITY USAGE = 6 LAMPS x 60W PER LAMP = 360 W OR .36KW/H
NEW ELECTRICITY USAGE = 0.096 KW/H
TOTAL ELECTRICTY SAVED = 0.36 KW/H - 0.096 KW/H = 0.264 KW/H

YEARLY SAVINGS = 0.264 KW/H x $0.0425 /KWH x 8760 HOURS/YEAR = $98.29 PER YEAR

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOE2
ANALYSIS DATE: 03-23-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	124.
B. SIOH	$	7.
C. DESIGN COST	$	7.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	124.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	124.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	8.	$ 100.	11.16	1116.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	0.	$ 0.	16.15	0.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		8.	$ 100.		$ 1116.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 368.
A IF 3D1 IS = OR > 3C GO TO ITEM 4.
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 100.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 1116.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 9.00
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 1.24

ECO-E3

ENERGY EFFICIENT MOTORS

ENERGY EFFICIENT MOTORS

ENERGY CONSERVATION OPPORTUNITY: ECO-E3

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-E3) analyzes energy savings in replacing inefficient motors with energy efficient motors. This project includes investigating any power factor charges the USDB is charged.

SCOPE:

This ECO simulation (ECO-E3) determines motor sizes that can be replaced to conserve electricity. This project also determines methods of power factor reduction if the USDB pays a high power factor penalty. The application of this project was considered for the following buildings:

Building	463	Building	475
Building	464	Building	475C
Building	465	Building	475D
Building	472	Building	475F
Building	473	Building	475G
Building	474		

MODELING TECHNIQUES:

The Fort Leavenworth USDB power supplier (KPL Gas Service) was contacted. The supplier confirmed that Fort Leavenworth would be charged a power factor penalty, but added that the Fort maintains a power factor of near 100% (or 1) and has not been charged a power factor penalty in the past. Therefore, no changes are required in the USDB power factor.

The modeling technique used to justify motor replacement with high efficiency motors was based on the removal of existing low efficiency motors, replacing them with high efficiency motors, and analyzing energy saved per year based on estimated running time. A sample Life Cycle Cost analysis showing how the SIR's were calculated on each individual motoris included on page E3-21.

ECO IMPLEMENTATION:

ECO implementation will include removal of motors and replacement with high efficiency motors.

SUMMARY:

Because the Fort Leavenworth complex power factor is nearly 100% (or 1) at all times, no power factor correction is recommended.

Average efficiencies and energy savings for various motor sizes and their associated payback times are shown on page E3-3.

Efficiency and watt loss data for various motor sizes are shown on page E3-4.

Energy savings, SIR's, and payback times for various motors in USDB buildings are shown on pages E3-5 and E3-6.

Installation costs for various motor sizes are shown on pages E3-7 to E3-19.

Life cycle cost analysis for this ECO is shown on page E3-20. Only those motors with an SIR of greater than one are included in the analysis.

RECOMMENDATIONS

We recommend replacement of all motors listed on pages E3-5 and E3-6 where calculated SIR values are greater than one. All of the motors listed on those pages are nearing the end of efficient life. Therefore, we recommend that all new motors installed at the USDB during regular maintenance and replacement be high efficiency motors.

AVERAGE EFFICIENCIES AND ENERGY SAVINGS FOR VARIOUS MOTOR SIZES STANDARD VS HIGH EFFICIENCY PAYBACKS FOR REPLACING AN EXISTING MOTOR

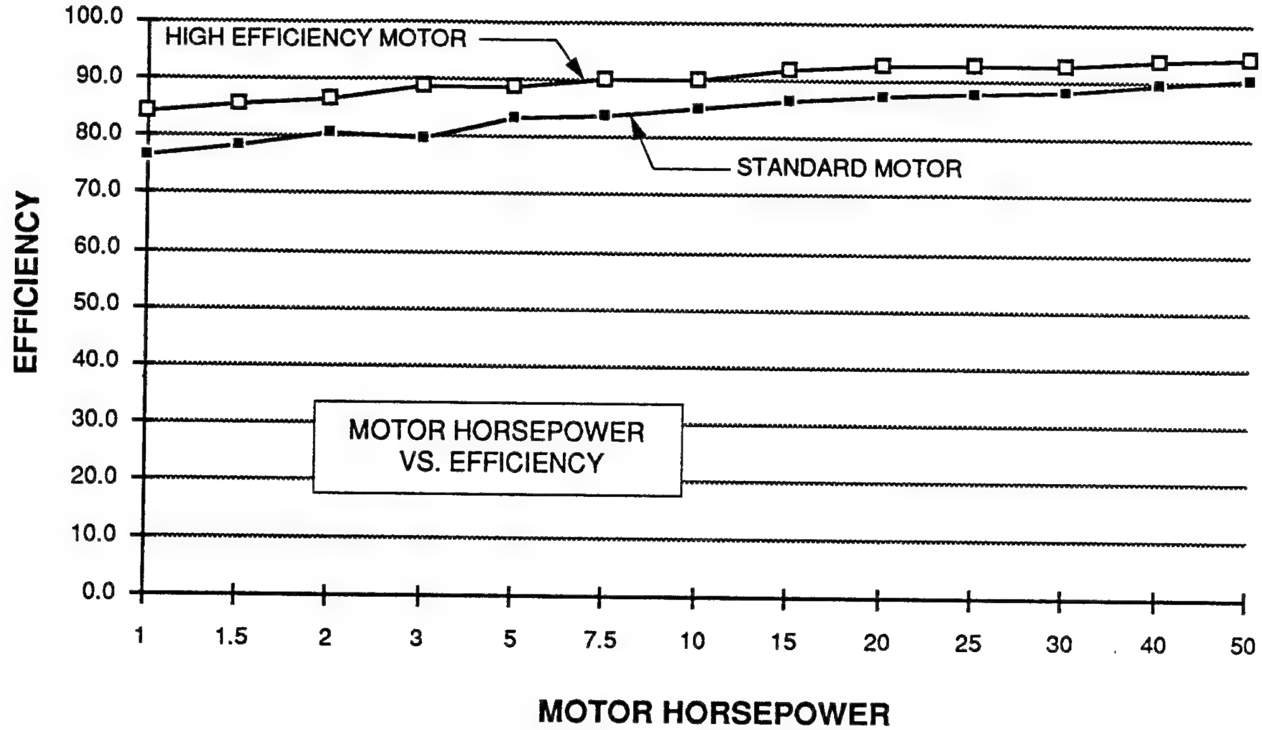
HORSE-POWER	STANDARD MOTOR EFFICIENCY	HI EFF MOTOR EFFICIENCY	STANDARD MOTOR WATT LOSS	HI EFF MOTOR WATT LOSS	WATT LOSS DIFFERENCE	INSTALLED HI EFF MTR COST
1	76.5	84.0	229	142	87	$420
1.5	78.5	85.5	306	190	117	$442
2	80.8	86.5	355	233	122	$466
3	79.9	88.5	563	291	272	$582
5	83.1	89.5	759	438	321	$644
7.5	83.8	90.2	1082	608	474	$820
10	85.0	90.2	1316	811	506	$966
15	86.5	91.7	1746	1013	734	$1,255
20	87.5	93.0	2131	1123	1008	$1,527
25	88.0	93.0	2543	1404	1139	$1,780
30	88.1	93.0	3023	1685	1338	$2,030
40	89.4	93.6	3538	2040	1498	$2,623
50	90.4	94.1	3961	2339	1622	$3,232

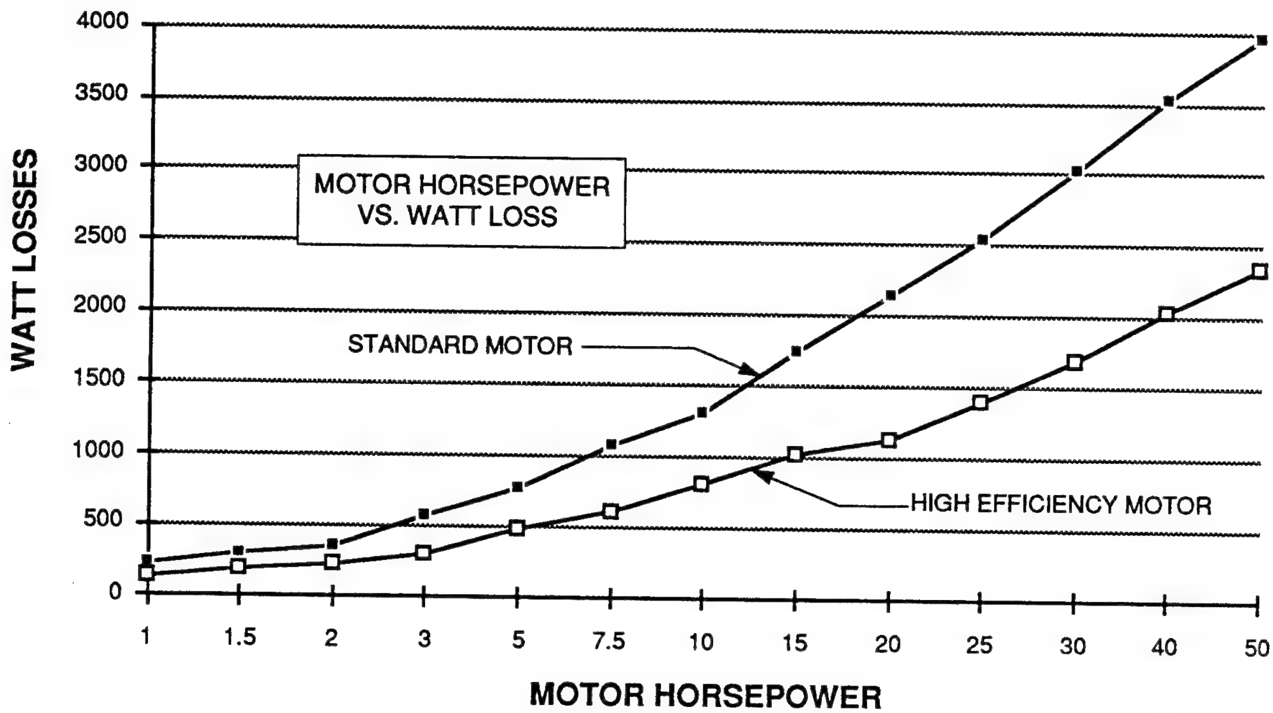
HORSE-POWER	8760 HOURS				5000 HOURS			
	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR
1	763	$32	13.0	0.9	435	$19	22.7	0.5
1.5	1,022	$43	10.2	1.1	584	$25	17.8	0.6
2	1,066	$45	10.3	1.1	608	$26	18.0	0.6
3	2,384	$101	5.7	1.9	1,361	$58	10.1	1.1
5	2,812	$119	5.4	2.0	1,605	$68	9.4	1.2
7.5	4,150	$176	4.6	2.4	2,369	$101	8.1	1.4
10	4,432	$188	5.1	2.2	2,530	$108	9.0	1.2
15	6,426	$273	4.6	2.4	3,668	$156	8.1	1.4
20	8,834	$375	4.1	2.7	5,042	$214	7.1	1.5
25	9,981	$424	4.2	2.6	5,697	$242	7.4	1.5
30	11,725	$498	4.1	2.7	6,692	$284	7.1	1.5
40	13,120	$558	4.7	2.3	7,489	$318	8.2	1.3
50	14,212	$604	5.4	2.1	8,112	$345	9.4	1.2

HORSE-POWER	4380 HOURS				2920 HOURS			
	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR
1	381	$16	25.9	0.4	254	$11	38.9	0.3
1.5	511	$22	20.3	0.5	341	$14	30.5	0.4
2	533	$23	20.6	0.5	355	$15	30.9	0.4
3	1,192	$51	11.5	1.0	795	$34	17.2	0.6
5	1,406	$60	10.8	1.0	937	$40	16.2	0.7
7.5	2,075	$88	9.3	1.2	1,383	$59	13.9	0.8
10	2,216	$94	10.3	1.1	1,477	$63	15.4	0.7
15	3,213	$137	9.2	1.2	2,142	$91	13.8	0.8
20	4,417	$188	8.1	1.4	2,945	$125	12.2	0.9
25	4,991	$212	8.4	1.3	3,327	$141	12.6	0.9
30	5,862	$249	8.1	1.4	3,908	$166	12.2	0.9
40	6,560	$279	9.4	1.2	4,373	$186	14.1	0.8
50	7,106	$302	10.7	1.0	4,737	$201	16.1	0.7

25 YEAR DISCOUNT FACTOR = 11.16

ELECTRICITY COST = 4.25¢/KWH





THESE GRAPHS ARE BASED ON INFORMATION PUBLISHED BY RELIANCE ELECTRIC CORPORATION.

CALCULATION SHEET	DATE Mar-90	SHEET OF 1 2
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KS	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-E3	COMPUTED BY DJG	CHECKED BY MAW

BUILDING # AND MOTOR DESCRIPTION	HP	OPER. HOURS/ YEAR	SAVINGS PER YEAR MBTU'S	SAVINGS PER YEAR DOLLARS	INSTALLED COST	SIR	PAYBACK YEARS
BUILDING 463 FAN	1.5	4380	1.7	$21.15	$442	0.5	20.9
BUILDING 463 CONDENSING UNIT	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 464 FAN	1.5	4380	1.7	$21.15	$442	0.5	20.9
BUILDING 464 FAN	1.5	4380	1.7	$21.15	$442	0.5	20.9
BUILDING 465 COMPRESSOR	5	5000	5.5	$68.42	$644	1.2	9.4
BUILDING 465 COMPRESSOR	5	5000	5.5	$68.42	$644	1.2	9.4
BUILDING 465 COLD WATER PUMP	1.5	4380	1.7	$21.15	$442	0.5	20.9
BUILDING 465 HOT WATER PUMP	7.5	4380	7.1	$88.32	$820	1.2	9.3
BUILDING 465 AIR HANDLING UNIT	2	4380	1.8	$22.39	$466	0.5	20.8
BUILDING 465 AIR HANDLING UNIT	1	4380	1.3	$16.17	$420	0.4	26.0
BUILDING 465 AIR HANDLING UNIT	1	4380	1.3	$16.17	$420	0.4	26.0
BUILDING 472 HOT WATER PUMP	3	4380	4.1	$51.00	$582	1.0	11.4
BUILDING 472 FAN	1.5	4380	1.7	$21.15	$442	0.5	20.9
BUILDING 473 HOT WATER PUMP	3	4380	4.1	$51.00	$582	1.0	11.4
BUILDING 473 HOT WATER PUMP	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 474 BOILER FEED PUMP	40	8760	44.8	$557.31	$2,623	2.4	4.7
BUILDING 474 FAN	10	8760	15.1	$187.84	$966	2.2	5.1
BUILDING 474 FAN	10	8760	15.1	$187.84	$966	2.2	5.1
BUILDING 474 FAN	10	8760	15.1	$187.84	$966	2.2	5.1
BUILDING 474 CONDENSATE PUMP	10	8760	15.1	$187.84	$966	2.2	5.1
BUILDING 474 CONDENSATE PUMP	10	8760	15.1	$187.84	$966	2.2	5.1
BUILDING 474 AIR COMPRESSOR	3	8760	8.1	$100.76	$582	1.9	5.8
BUILDING 474 AIR COMPRESSOR	25	8760	34.1	$424.20	$1,780	2.7	4.2

25-YEAR DISCOUNT FACTOR= 11.16

CALCULATION SHEET	DATE Mar-90	SHEET 0F 2 2
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KS	X HAND ___ COMPUTER ___ CONTRACTOR BID OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		
ECO MEASURE ECO-E3	COMPUTED BY DJG	CHECKED BY MAW

BUILDING # AND MOTOR DESCRIPTION	HP	OPER. HOURS/ YEAR	SAVINGS PER YEAR MBTU'S	SAVINGS PER YEAR DOLLARS	INSTALLED COST	SIR	PAYBACK YEARS
BUILDING 475 ROTUNDA CONDENSING UNIT	3	4380	4.1	$51.00	$582	1.0	11.4
BUILDING 475 ROTUNDA CONDENSING UNIT	7.5	4380	7.1	$88.32	$820	1.2	9.3
BUILDING 475C FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475C FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475D FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475D FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475F FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475F FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475G FAN	5	4380	4.8	$59.71	$644	1.0	10.8
BUILDING 475G FAN	5	4380	4.8	$59.71	$644	1.0	10.8
TOTAL (SIR > 1)			248	$3,085.00	$20,929	1.6	6.8

25-YEAR DISCOUNT FACTOR= 11.16

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 16-Mar-90

SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY

LOCATION: FORT LEAVENWORTH, KANSAS

ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP

DRAWING NO.: 1 HORSEPOWER MOTOR REPLACE

BASIS FOR ESTIMATE

X CODE A (NO DESIGN COMPLETED)
CODE B (PRELIMINARY DESIGN)
CODE C (FINAL DESIGN)
OTHER (SPECIFY)

ESTIMATOR: DJG

CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
1 HP ENERGY EFFICIENT MOTOR	1	EA	$40.00	$40	$148.00	$148	$188
MOTOR CONNECTION	1	EA	$23.00	$23	$3.15	$3	$26
SUBTOTAL				$107		$151	$258
CONTINGENCY			10%	$11	10%	$15	$26
				$118		$166	$284
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$16	3.50%	$6	$22
DIRECT COST				$134		$172	$306
OVERHEAD & PROFIT						25.0%	$76
CONSTRUCTION COST							$382
SIOH						10.0%	$38
TOTAL PROJECT COST							$420

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1
PROJECT: ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP	___ CODE B (PRELIMINARY DESIGN) ___ CODE C (FINAL DESIGN) ___ OTHER (SPECIFY)	
DRAWING NO.: 1.5 HORSEPOWER MOTOR REPLACE	ESTIMATOR: DJG	CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
1.5 HP ENERGY EFFICIENT MOTOR	1	EA	$40.00	$40	$162.00	$162	$202
MOTOR CONNECTION	1	EA	$23.00	$23	$3.15	$3	$26
SUBTOTAL				$107		$165	$272
CONTINGENCY			10%	$11	10%	$17	$27
				$118		$182	$299
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$16	3.50%	$6	$22
DIRECT COST				$134		$188	$322
OVERHEAD & PROFIT						25.0%	$80
CONSTRUCTION COST							$402
SIOH						10.0%	$40
TOTAL PROJECT COST							$442

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER CLARK, RICHARSON, & BISKUP	CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO. 2 HORSEPOWER MOTOR REPLACE	ESTIMATOR DJG	CHECKED BY MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
2 HP ENERGY EFFICIENT MOTOR	1	EA	$40.00	$40	$177.00	$177	$217
MOTOR CONNECTION	1	EA	$23.00	$23	$3.15	$3	$26
SUBTOTAL				$107		$180	$287
CONTINGENCY			10%	$11	10%	$18	$29
				$118		$198	$316
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$16	3.50%	$7	$23
DIRECT COST				$134		$205	$339
OVERHEAD & PROFIT						25.0%	$85
CONSTRUCTION COST							$423
SIOH						10.0%	$42
TOTAL PROJECT COST							**$466**

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1
PROJECT: ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED)	
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP	CODE B (PRELIMINARY DESIGN)	
	CODE C (FINAL DESIGN)	
	OTHER (SPECIFY)	
DRAWING NO.: 3 HORSEPOWER MOTOR REPLACE	ESTIMATOR: DJG	CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
3 HP ENERGY EFFICIENT MOTOR	1	EA	$40.00	$40	$245.00	$245	$285
MOTOR CONNECTION	1	EA	$28.00	$28	$3.70	$4	$32
SUBTOTAL				$112		$249	$361
CONTINGENCY			10%	$11	10%	$25	$36
				$123		$274	$397
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$17	3.50%	$10	$26
DIRECT COST				$140		$283	$423
OVERHEAD & PROFIT						25.0%	$106
CONSTRUCTION COST							$529
SIOH						10.0%	$53
TOTAL PROJECT COST							$582

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED)
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP	CODE B (PRELIMINARY DESIGN)
	CODE C (FINAL DESIGN)
	OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
5 HORSEPOWER MOTOR REPLACE	DJG	MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
5 HP ENERGY EFFICIENT MOTOR	1	EA	$40.00	$40	$285.00	$285	$325
MOTOR CONNECTION	1	EA	$28.00	$28	$3.70	$4	$32
SUBTOTAL				$112		$289	$401
CONTINGENCY			10%	$11	10%	$29	$40
				$123		$318	$441
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$17	3.50%	$11	$28
DIRECT COST				$140		$329	$469
OVERHEAD & PROFIT						25.0%	$117
CONSTRUCTION COST							$586
SIOH						10.0%	$59
TOTAL PROJECT COST							$644

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY

LOCATION: FORT LEAVENWORTH, KANSAS

ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP

BASIS FOR ESTIMATE:

- X CODE A (NO DESIGN COMPLETED)
- CODE B (PRELIMINARY DESIGN)
- CODE C (FINAL DESIGN)
- OTHER (SPECIFY)

DRAWING NO.: 7.5 HORSEPOWER MOTOR REPLACE

ESTIMATOR: DJG

CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
7.5 HP ENERGY EFFICIENT MOTOR	1	EA	$43.00	$43	$388.00	$388	$431
MOTOR CONNECTION	1	EA	$33.00	$33	$4.40	$4	$37
SUBTOTAL				$120		$392	$512
CONTINGENCY			10%	$12	10%	$39	$51
				$132		$432	$564
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$18	3.50%	$15	$33
DIRECT COST				$150		$447	$597
OVERHEAD & PROFIT						25.0%	$149
CONSTRUCTION COST							$746
SIOH						10.0%	$75
TOTAL PROJECT COST							$820

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1
PROJECT: ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE	
LOCATION: FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)	
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP		
DRAWING NO.: 10 HORSEPOWER MOTOR REPLACE	ESTIMATOR: DJG	CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
10 HP ENERGY EFFICIENT MOTOR	1	EA	$45.00	$45	$468.00	$468	$513
MOTOR CONNECTION	1	EA	$43.00	$43	$4.40	$4	$47
SUBTOTAL				$132		$472	$604
CONTINGENCY			10%	$13	10%	$47	$60
				$145		$520	$665
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$20	3.50%	$18	$38
DIRECT COST				$165		$538	$703
OVERHEAD & PROFIT						25.0%	$176
CONSTRUCTION COST							$878
SIOH						10.0%	$88
TOTAL PROJECT COST							$966

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER CLARK, RICHARSON, & BISKUP	CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
15 HORSEPOWER MOTOR REPLACE	DJG	MAW

	QUANTITY		LABOR		MATERIAL		TOTAL
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	COST
MOTOR REMOVAL	1	EA	$44.00	$44		$0	$44
15 HP ENERGY EFFICIENT MOTOR	1	EA	$57.00	$57	$625.00	$625	$682
MOTOR CONNECTION	1	EA	$55.00	$55	$5.65	$6	$61
SUBTOTAL				$156		$631	$787
CONTINGENCY			10%	$16	10%	$63	$79
				$172		$694	$865
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$23	3.50%	$24	$47
DIRECT COST				$195		$718	$913
OVERHEAD & PROFIT						25.0%	$228
CONSTRUCTION COST							$1,141
SIOH						10.0%	$114
TOTAL PROJECT COST							**$1,255**

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE
LOCATION: FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED)
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP	CODE B (PRELIMINARY DESIGN)
	CODE C (FINAL DESIGN)
	OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
20 HORSEPOWER MOTOR REPLACE	DJG	MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$55.00	$55		$0	$55
20 HP ENERGY EFFICIENT MOTOR	1	EA	$70.00	$70	$754.00	$754	$824
MOTOR CONNECTION	1	EA	$67.00	$67	$10.60	$11	$78
SUBTOTAL				$192		$765	$957
CONTINGENCY			10%	$19	10%	$76	$96
				$211		$841	$1,052
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$29	3.50%	$29	$58
DIRECT COST				$240		$870	$1,110
OVERHEAD & PROFIT						25.0%	$278
CONSTRUCTION COST							$1,388
SIOH						10.0%	$139
TOTAL PROJECT COST							$1,527

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1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY

LOCATION: FORT LEAVENWORTH, KANSAS

ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP

BASIS FOR ESTIMATE:
- X CODE A (NO DESIGN COMPLETED)
- CODE B (PRELIMINARY DESIGN)
- CODE C (FINAL DESIGN)
- OTHER (SPECIFY)

DRAWING NO.: 25 HORSEPOWER MOTOR REPLACE | ESTIMATOR: DJG | CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$55.00	$55		$0	$55
25 HP ENERGY EFFICIENT MOTOR	1	EA	$72.00	$72	$914	$914	$986
MOTOR CONNECTION	1	EA	$67.00	$67	$10.60	$11	$78
SUBTOTAL				$194		$925	$1,119
CONTINGENCY			10%	$19	10%	$92	$112
				$213		$1,017	$1,230
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$29	3.50%	$36	$64
DIRECT COST				$242		$1,053	$1,295
OVERHEAD & PROFIT						25.0%	$324
CONSTRUCTION COST							$1,619
SIOH						10.0%	$162
TOTAL PROJECT COST							$1,780

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1AVC-59

CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT ENERGY SAVING OPPORTUNITY SURVEY	BASIS FOR ESTIMATE
LOCATION FORT LEAVENWORTH, KANSAS	X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN)
ARCHITECT/ENGINEER CLARK, RICHARSON, & BISKUP	CODE C (FINAL DESIGN) OTHER (SPECIFY)

DRAWING NO.	ESTIMATOR	CHECKED BY
30 HORSEPOWER MOTOR REPLACE	DJG	MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$55.00	$55		$0	$55
30 HP ENERGY EFFICIENT MOTOR	1	EA	$76.00	$76	$1,069	$1,069	$1,145
MOTOR CONNECTION	1	EA	$67.00	$67	$10.60	$11	$78
SUBTOTAL				$198		$1,080	$1,278
CONTINGENCY			10%	$20	10%	$108	$128
				$218		$1,188	$1,405
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$29	3.50%	$42	$71
DIRECT COST				$247		$1,229	$1,476
OVERHEAD & PROFIT						25.0%	$369
CONSTRUCTION COST							$1,845
SIOH						10.0%	$185
TOTAL PROJECT COST							$2,030

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY

LOCATION: FORT LEAVENWORTH, KANSAS

ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP

DRAWING NO.: 40 HORSEPOWER MOTOR REPLACE

BASIS FOR ESTIMATE

X CODE A (NO DESIGN COMPLETED)
CODE B (PRELIMINARY DESIGN)
CODE C (FINAL DESIGN)
OTHER (SPECIFY)

ESTIMATOR: DJG

CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$60.00	$60		$0	$60
40 HP ENERGY EFFICIENT MOTOR	1	EA	$91.00	$91	$1,390	$1,390	$1,481
MOTOR CONNECTION	1	EA	$82.00	$82	$30.00	$30	$112
SUBTOTAL				$233		$1,420	$1,653
CONTINGENCY			10%	$23	10%	$142	$165
				$256		$1,562	$1,818
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$35	3.50%	$55	$89
DIRECT COST				$291		$1,617	$1,908
OVERHEAD & PROFIT						25.0%	$477
CONSTRUCTION COST							$2,384
SIOH						10.0%	$238
TOTAL PROJECT COST							$2,623

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CONSTRUCTION COST ESTIMATE	DATE PREPARED 3/16/90	SHEET 1 OF 1

PROJECT: ENERGY SAVING OPPORTUNITY SURVEY
LOCATION: FORT LEAVENWORTH, KANSAS
ARCHITECT/ENGINEER: CLARK, RICHARSON, & BISKUP
DRAWING NO.: 50 HORSEPOWER MOTOR REPLACE

BASIS FOR ESTIMATE
X CODE A (NO DESIGN COMPLETED)
CODE B (PRELIMINARY DESIGN)
CODE C (FINAL DESIGN)
OTHER (SPECIFY)

ESTIMATOR: DJG
CHECKED BY: MAW

	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MOTOR REMOVAL	1	EA	$60.00	$60		$0	$60
50 HP ENERGY EFFICIENT MOTOR	1	EA	$115.00	$115	$1,753	$1,753	$1,868
MOTOR CONNECTION	1	EA	$82.00	$82	$30.00	$30	$112
SUBTOTAL				$257		$1,783	$2,040
CONTINGENCY			10%	$26	10%	$178	$204
				$283		$1,961	$2,244
WORK COMP, SOC. SEC., INS., TAXES			13.50%	$38	3.50%	$69	$107
DIRECT COST				$321		$2,030	$2,351
OVERHEAD & PROFIT						25.0%	$588
CONSTRUCTION COST							$2,939
SIOH						10.0%	$294
TOTAL PROJECT COST							$3,232

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1AVC-59

Sample for 10 hp

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOE3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	20929.
B. SIOH	$	1256.
C. DESIGN COST	$	1151.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	21002.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	21002.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL		UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELECT	$	12.44	248.	$	3085.	11.16		34429.
B. DIST	$	.00	0.	$	0.	17.19		0.
C. RESID	$	.00	0.	$	0.	17.12		0.
D. NAT G	$	4.08	0.	$	0.	16.15		0.
E. COAL	$	.00	0.	$	0.	13.92		0.
F. TOTAL			248.	$	3085.		$	34429.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 11362.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 3085.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 34429.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.64
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.81

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990 DISCRETE PORTION NAME: ECOE3
ANALYSIS DATE: 03-30-90 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	$	878.
B. SIOH	$	53.
C. DESIGN COST	$	48.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$	881.
E. SALVAGE VALUE COST	-$	0.
F. TOTAL INVESTMENT (1D-1E)	$	881.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 12.44	15.	$ 187.	11.16	2087.
B. DIST	$ .00	0.	$ 0.	17.19	0.
C. RESID	$ .00	0.	$ 0.	17.12	0.
D. NAT G	$ 4.08	0.	$ 0.	16.15	0.
E. COAL	$ .00	0.	$ 0.	13.92	0.
F. TOTAL		15.	$ 187.		$ 2087.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 11.65
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) $ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 689.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)= ________
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) $ 187.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 2087.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.37
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 4.71

REFERENCES

REFERENCES

1. COOLING AND HEATING LOAD CALCULATION MANUAL, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329.

2. ASHRAE HANDBOOK, 1981 FUNDEMENTALS, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329.

3. ENERGY ENGINEERING, Journal of the Association of Energy Engineers, The Fairmont Press, Inc., 700 Indian Trail, Lilburn, GA 30247.

4. ASHRAE HANDBOOK, 1977 FUNDEMENTALS, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 345 East 47th Street, New York, NY 10017.

SCOPE OF WORK

GENERAL SCOPE OF WORK

ENERGY SURVEY FOR THE

UNITED STATES DISCIPLINARY BARRACKS (USDB)

AT

FORT LEAVENWORTH, KANSAS

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK
ENERGY SURVEY FOR THE UNITED STATES DISCIPLINARY
BARRACKS (USDB) AT FORT LEAVENWORTH, KANSAS

ENERGY ENGINEERING ANALYSIS PROGRAM

TABLE OF CONTENTS

1. <u>BRIEF DESCRIPTION OF WORK:</u> The Architect-Engineer (AE) shall:

1.1 Perform a complete energy audit and analysis of the USDB.

1.2 Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.

1.3 Prepare programming documentation [DD Form 1391, Life Cycle Cost Analysis Summary Sheet with backup calculations and Project Development Brochure (PDB)] for any Energy Conservation Investment Program (ECIP) and MCA projects.

1.4 Prepare implementation documentation for all justifiable energy conservation opportunities.

1.5 List and prioritize all recommended energy conservation opportunities.

1.6 Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

2. <u>GENERAL</u>

2.1 An energy study, including a detailed energy survey, shall be accomplished for the USDB. The study shall integrate the results of and any available data from prior or ongoing energy conservation studies, projects, designs, or plans with work done under this contract. This Scope of Work is not intended to prescribe the details in which the studies are to be conducted or limit the AE in the exercise of his professional engineering expertise, good judgment or investigative ingenuity. However, the information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study. The study shall include a comprehensive energy report documenting study methods and results.

2.2 An Energy Engineering Analysis Program (EEAP) study has been accomplished for the installation at which the USDB is located. The portions of the study applicable to the USDB, if any, shall be incorporated into this study. This report shall list the recommended USDB related ECOs from the previous study. This list shall identify the previous study, summarize the USDB related ECOs and the anticipated energy savings, and identify the fiscal year for which the project was or is programmed. The backup calculations and project documentation from the previous study shall be reproduced and included as a appendix to the report. Any USDB related ECOs shall be reevaluated under this contract. Any USDB related ECOs recommended from the previous studies but not implemented nor programmed for implementation shall be updated in accordance with the latest ECIP guidance.

2.3 The AE shall ensure that all methods of energy conservation pertaining to USDB, which will reduce the energy consumption of the installation in compliance with the Army Facilities Energy Plan, have been considered and documented. All methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as physical facilities. All new and updated energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunities considered infeasible shall be documented in the report with reasons for eliminating. A list of general energy conservation opportunities (ECOs) is included as Annex A to this scope. This list shall be considered and the evaluation of each ECO documented in the report. This list is not intended to be restrictive but only to assure that at least these opportunities are addressed in the report. Some of the energy conservation opportunities in Annex A may not be applicable. A statement to that effect in the report is all that is required.

2.4 The study shall consider the use of all energy sources. The energy sources include electric, natural gas, liquefied petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, solar, etc.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance," described in a letter from DAEN-MPO-U, 10 August 1982 and revised by letters from DAEN-ZCF-U, 4 March 1985 and 11 June 1986, establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 submission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.6 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.7 All recommended ECOs, including maintenance, operation and low cost , no cost opportunities shall be ranked in order of highest to lowest Savings Investment Ratio (SIR). Projects, after they are determined, shall be categorized by type and ranked within each category in order of highest to lowest SIR.

2.8 Projects which qualify for ECIP funding shall be identified, separately listed, prioritized by Saving Investment Ratio (SIR).

2.9 All energy conservation opportunities shall be listed and prioritized by SIR.

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer of the Fort Leavenworth DEH will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary in the accomplishment of the work required under this contract.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records.

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a r+eproducible copy of the record or receipt.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government/furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of receipt.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Engineering and Housing and USDB representative before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall thoroughly brief and describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing and USDB representatives.

3.7.2 Exit. The exit interview shall include a thorough briefing describing the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Engineering and Housing and USDB representatives.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendency and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities (ECO') shall be included in one of the following categories and presented in the report as such.

5.1 ECIP Projects. To qualify as an ECIP project, and ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000, a Saving Investment Ratio (SIR) greater than one and a simple payback period of less than ten years. The overall project, and each discrete part of the project, shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, Life Cycle Cost Analysis Summary Sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A Life Cycle Cost Analysis Summary Sheet shall be developed for each ECO and for the overall project when more than one ECO is combined. For projects and ECOs developed from previous studies, the backup data shall consist of copies of the original calculation and analysis, with new pages updating and revising the original calculation and analysis. In addition, the backup data shall include as much of the following as is available: The increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to prevent duplication of projects in any future reports.

5.2 MCA Projects. To qualify as a MCA project, and ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000 and a Saving Investment Ratio (SIR) greater than one. The overall project, and each discrete part of the project, shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, Life Cycle Cost Analysis Summary Sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A Life Cycle Cost Analysis Summary Sheet shall be developed for each ECO and for the overall project when more than one ECO is combined.

5.3 Non-ECIP Projects. Projects which normally do not meet ECIP criteria, but which have an overall SIR greater than one shall be documented. The Life Cycle Cost Analysis Summary Sheet shall be completed through and including line 6 for all projects or ECOs. Each project shall be analyzed to determine if it is feasible even if it does not meet ECIP criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the Life Cycle Cost Analysis Summery Sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost not over $100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost greater than $100,000 and a simple payback period of four years or less.

c. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of more than;$3,000 and a simple payback period of four years or less.

The programs are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,,000 and a simple payback period of ten to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332.

e. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing can perform with his funds.

5.4 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. <u>DETAILED SCOPE OF WORK.</u> The general Scope of Work is intended to apply to contract efforts for the USDB included under this contract except as modified by the detailed Scope of Work. The detailed Scope of Work is contained in Annex B.

7. <u>WORK TO BE ACCOMPLISHED</u>

7.1 <u>Audit and Analysis</u>

7.1.1 Audit. The audit consists of gathering data and inspecting the USDB in the field. These activities shall be closely coordinated with the Government's representative, the Director of Engineering and Housing and USDB representatives. The AE shall become familiar with the USDB and undertake field trips to obtain required data. The AE shall document his field surveys on forms developed for the survey, or standard forms, and submit the completed forms as part of the report. Data sources shall be identified and assumptions clearly stated and justified. Data collected during the audit shall be in sufficient detail to identify all the major energy using equipment and processes. The AE shall measure and record the voltage and amperage of all motors one horsepower and larger. The information gathered shall be compared to the name plate data to determine whether the motor is being properly utilized. Data should be gathered when the motor is loaded. Air handling system supply, return and exhaust air quantities, temperatures, relative humidities, lighting levels, and similar data shall be based on measurements made during the audit and not on "as-built" drawings. All test and/or measurement equipment shall be properly calibrated prior to its use. Operating sequences for equipment, control schedules, facility operating hours, methods of operation, and past performance records should also be obtained during the audit. DEH SUPPORT

7.1.2 <u>Analysis.</u> The energy analysis is a comprehensive study of the USDB's energy usage. It includes a detailed investigation of the facilities operation, its environment and its equipment. The energy analysis shall provide the following types of information: (a) a baseline of energy usage of the existing USDB, (b) peak heating and cooling loads, (c) energy usage by systems (lighting, heating, cooling, domestic hot water, etc.), (d) a basis for evaluating ECOs, and (e) a baseline of energy usage of the USDB after incorporation of all recommended ECOs. The AE shall develop graphic presentations, i.e., graphs and charts, which depict a complete energy consumption picture for the USDB as they are now and after implementation of the recommended energy conservation opportunities.

7.1.3 Computer Modeling. The analysis shall use computer modeling. Computer modeling shall be used to incorporate field survey data, weather data, occupancy schedules, building construction data, energy distribution systems and equipment data into a model of the total facility. The computer program shall be used to develop load profiles, calculate energy savings, and evaluate energy conservation opportunities. The computer program shall be capable of analyzing the energy requirements of buildings, performance of heating, cooling, and ventilating equipment, (energy distribution systems, and energy conversion equipment.) The computer results shall be verified by comparing them to any available utility bills or records. The computer program shall analyze the facility on an hour-by-hour basis rather than the bin data method of bin data to simulate an hour-by-hour analysis.

Unless the Building Loads Analysis and Systems Thermodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis. The computer program used must be comparable to the BLAST program.

7.2 Identify ECOs. All methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures and maintenance practices as well as the physical facilities. A list of energy conservation opportunities is included as Annex A to this scope. This list is not intended to e restrictive but only to assure that at least these opportunities are considered in the report. Each of the items shall be considered and discussed in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall provide all data needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. A Life Cycle Cost Analysis Summary Sheet shall be prepared for each ECO and included as part of the supporting data for ECOs which would replace the existing heating, ventilating, and air conditioning (HVAC) system or significantly change it (such as converting a multizone system to a variable air volume (HVAV system) the AE is required to run a computer simulation to analyze the system and to determine the energy savings. This requirement to use computer modeling applies only to heated and air conditioned or air conditioned only buildings which exceed 8,000 square feet or heated only buildings in excess of 20,000 square feet. The computer program shall analyze the building on an hour-by- hour basis rather than the bin data method or bin data to simulate an hour-by-hour analysis. Unless the Building Loads Analysis and System Termodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval of the Contracting Officer prior to use of the program for analysis. The computer program used must be comparable to the BLAST program.

7.3 Prepare Programming Documentation for ECIP Projects. For ECOs which meet ECIP criteria or ECOs which can be combined to meet ECIP criteria, complete programming documentation shall be prepared. Complete programming documentation consists of DD Form 1391, PDB and supporting data. These forms shall be separate from the report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly. A sample programming document shall be submitted for review and approval with the interim submittal. This sample shall be submitted and approved prior to the preparation of any other programming documentation. To the degree possible, the project selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. The sample shall consist of complete programming documentation with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy saving data.

7.3.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex C. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation personnel. All documents shall be completed except for the required signatures.

7.3.2 Project Development Brochure (PDB). Preparation of the PDB requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

7.3.3 Supporting Data. The AE shall provide all data and calculations needed to support the recommended project. Descriptions of the products, manufacturers catalog cuts,pertinent drawings and sketches shall also be included. A Life Cycle Cost Analysis Summary Sheet shall be prepared for each ECIP project and each discrete part of the project and included as part of the supporting data.

7.4 Prepare Implementation Documentation. For feasible projects or ECOs which normally do not meet ECIP criteria, implementation documentation shall be prepared. Each feasible project or ECO shall be individually packaged and fully documented and included as a separate section in the volume containing the programming documentation. Each project or ECC shall have a complete description of the changes required, economic justifications, sketches, and other backup data included as a section in the report. The documentation required will be as determined by the Governments's representative. Documentation required will be in the categories listed in paragraph 5.3. For the QRIP, OSD PIF and PECIP projects, documentation shall be prepared in accordance with the requirements of AR 5-4, Change No. 1. For MCA projects the documentation required by ETL 1110-3-332 shall be included in lieu of the ECIP Life Cycle Cost Analysis. For low cost/no cost projects which the Director of Engineering and Housing personnel can perform, the following information shall be provided.

a. Brief description of the project.

b. Brief description of the reasons for the modification.

c. Specific instructions for performing the modification.

d. Estimated dollar and energy saving per year.

e. Estimated man-hours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Man-hours shall be listed by trade. For projects that would repair and existing system so that it will function properly, also include the estimated man-hours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis.

An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications. Separate sheets for each project showing the above information shall be prepared and included in the report.

7.5 List and Prioritize All Projects.

7.5.1 The AE shall list and prioritize all energy conservation opportunities by saving investment ratios.

7.5.2 The AE shall list and prioritize all projects by types of projects and savings investments ratios.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to; installation, command, and other government personnel. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide all comments and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes. A sample programming document (DD Form 1391, PDB, and supporting data) for one ECIP project shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they should be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied, and any modifications to the Scope of Work, as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. Completed programming and implementation documents for all recommended new projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal report, Executive Summary, and all appendices will be bound in standard three-ring binders which will allow repeated which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) a separately bound Executive Summary, to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (see Annex D for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the Life Cycle Cost Analysis Sheet: the cost construction plus SIOH), the annual energy savings type and amount), the annual dollar savings, the SIR and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. The simple payback period shall also be shown for these projects and ECOs.

7.6.3 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of the complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

ANNEX A
ENERGY CONSERVATION OPPORTUNITIES

Heating, ventilating, and air conditioning

1. Shut off air handing units whenever possible.
2. Reduce outside air intake when air must be heated or cooled before use.
3. Repair and maintain steam lines and steam traps.
4. Use outside air for free cooling whenever possible. (Dry bulb economizers)
5. Recover heating or cooling with energy recovery units.
6. Insulate ducts and piping.
7. Install night setback controls.
8. Install computerize energy monitoring and control system (EMCS). (Cycle fans and pumps, shead loads during peak use, etc.)
9. Maintain equipment (clean coils, maintain filters, repair and/or maintain equipment and controls).
10. Convert separate AC units to central plant.
11. Replace Current ventilation with new ventilation or replace current ventilation with new windows and HVAC.

Boiler plant

1. Reduce steam distribution pressure.
2. Increase boiler efficiency.
3. Repair, replace, or install condensate return system.
4. Insulate boiler and boiler piping.
5. Install economizer.
6. Install air preheater.
7. Check boilerfeed water chemistry program.
8. Clean boiler tubes.
9. Blowdown controls.
10. Boiler and chiller control modifications.
11. Water treatment to prevent tube fouling.
12. Blowdown heat recovery.
13. Oxygen trim controls.
14. Convert complete DB heating system from high pressure steam to hot water.
15. Convert high pressure steam to co-generation.

Lighting

1. Reduce lighting levels.
2. Convert to energy efficient systems.

Building envelope

1. Reduce infiltration by caulking and weather-stripping.
2. Install insulated glass or double glazed windows.
3. Install roof insulation.
4. Install loading dock seals.
5. Install vestibules on entrances.
6. Reduce window heat gain by solar shading, screening, curtains, or blinds.
7. Install wall insulation.
8. Prevent air stratification.

Electrical equipment

1. Install capacitors and synchronous motor to increase power factor.
2. Convert to energy efficient motors.

Plumbing

1. Reduce domestic hot water temperature.
2. Install flow restrictions. (Shower & sinks).
3. Install faucets which automatically shut off water flow.
4. Decentralize hot water heating.
5. Add pipe insulation.

Laundry

1. Install heat reclamation system for laundry wash water.
2. Install heat reclamation system on dryers.
3. Install heat reclamation system on irons.

Kitchen

1. Shut off range hood exhaust whenever possible.
2. Install high-efficiency steam control valves.
3. Shut off equipment and appliances whenever possible.
4. Install makeup air supply for exhaust.
5. Install heat reclamation system for exhaust heat.
6. Turn off lights in coolers.
7. Water heating heat pump.

ANNEX B

ENERGY SURVEY FOR THE
UNITED STATES DISCIPLINARY BARRACKS (USDB)
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)
FORT LEAVENWORTH, KANSAS

DETAILED SCOPE OF WORK

1. Brief Description of Work. This project involves a coordinated energy study, including a detailed energy survey for the United States Disciplinary Barracks (USDB) at Fort Leavenworth, Kansas. This study shall integrate the results of all prior to ongoing energy conservation. projects, designs or plans with work done under this contract.

2. Authorization. This project is authorized by CEHND-ED-PM letter dated 29 Nov 88, subject: Energy Engineering Analysis Program (EEAP) FY89 Budget.

3. Services to be performed by the Contractor. The A-E shall perform and shall assume responsibility for the accuracy of the work and completeness of the following services in connection with the above project in accordance with the General Scope of Work as amended by criteria and instruction listed herein. Quality of work accomplished under this contract will be a determining factor in consideration of the A/E for future work.

a. POC at Fort Leavenworth will be Mr. Richard Wilms at 913-684-5639.

b. POC at Kansas City District will be Mr. Robert McCormick at 816-426-2782.

c. POC at USDB will be Capt. Doane at 913-684-2560.

d. ECIP projects shall be estimated to and programmed for implementation as FY 95 projects.

e. Five 1391/PDB will be prepared. Should more or less be required, suitable adjustment to the contract price will be made.

f. The AE shall develop a long range plan to identify all projects needed to make the USDB complex an energy saving institution. Projects shall be grouped in accordance with existing funding guidance.

5. Distribution. Fifteen (15) sets of each submittal shall be furnished to reviewers in accordance with the following distribution schedule:

Commander U.S. Army Engineer District, Kansas City ATTN: CEMRKED-MF/McCormick 700 Federal Building Kansas City, MO 64106-2896	5 copies
Commander Missouri River Division ATTN: CEMRDED-MA/Whelchel PO Box 103, Downtown Station Omaha, Nebraska 68101-0103	2 copies
Commander CAC & Ft. Leavenworth ATTN: ATZL-GEH Building 85 Ft. Leavenworth, KS 66027-5020	5 copies
Commander USACE-CEEC-EE/Mr. D. Beranek 20 Massachusetts Avenue, NW Washington, DC 20314	1 copy
Commander HQ, TRADOC ATTN: ATEN-FE Fort Monroe, VA 23351	1 copy

Transmission of documents will be by express mail or other expedient means. Only two (2) copies of the survey forms will be provided, one to CEMRK-ED-MF and one to Fort Leavenworth.

6. Data, Information and Services to be Furnished by the Government. The Government will furnish the following data, information, and services:

a. A/E Instructions.

b. Energy Conservation Investment Program (ECIP) Guidance, dated 10 Aug 82, and revisions dated 4 Mar 85 and 11 June 86.

c. ETLs 1110-3-254, Use of Electric Power Comfort Space Heating, 1110-3-282, Energy Conservation, 1110-3-294, Interior Design Temperatures, 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded through the MCA Program, 1110-3-332, Economic Studies, 1110-3-354, Direct Digital Control of HVAC Systems and 1110-3-364, Storm Windows.

d. TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM 5-800-3, Project Development Brochure and TM 5-815-2, Energy Monitoring and Control Systems (EMCS).

e. AR 415-15, Military Construction Army (MCA) Program Development, AR 415-17, Cost Estimating for Military Programming, AR 415-20, Construction Project Development and Design Approval, AR 415-28, Department of the Army Facility Classes and Construction Categories, AR 415-35, Construction, Minor Construction, AR 420-10, General Provisions, Organization, Functions and Personnel, and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

f. An example of a currently completed programming document for an ECIP project.

7. Completion Schedule. The A/E shall complete the work and services for each increment as follows:

a. Interim submittal - within one hundred and eighty (180) calendar days of Notice to Proceed.

b. Prefinal Submittal - within sixty (60) calendar days of the interim submittal presentation and review conference.

c. Final submittal - within sixty (60) calendar days after prefinal submittal presentation and review conference.

The A/E shall allow a period of approximately forty five (45) days for review by Government forces for each submission. Presentation of each submission will occur upon completion of the review period for that submission.

8. Method of Payment.

a. Title I Services - Design. Payment for design work and services will be made in accordance with the following procedures:

Partial Payment. The Architect-Engineer shall prepare and submit to the U.S. Army Engineer District, Kansas City, partial payment estimates using ENG Form 93, which shall serve as the request for payment. All partial payments shall be based on work completed as of the 15th day of the report month and shall be submitted to the office of the Contracting Officer by the 18th day of the month. The pay estimate shall be submitted with ENG Form 93, in accordance with the "Instructions for Completion of ENG Form 93 - Payment Estimate, "dated 5 January 1983. The U.S. Army Engineer District, Kansas City, will prepare supporting payment documents after obtaining necessary approvals and forward all documents to the U.S. Army Engineer District, Omaha, for issuance of the payment check. All questions, regarding payments shall be directed to the U.S. Army Engineer District, Kansas City.

b. Additional Conferences. Payment for furnishing the services of technically qualified representatives to attend conferences other than the review conferences specified above, when so requested in writing by the Contracting Officer, will be made at rate per hour for the discipline involved plus travel expenses computed in accordance with Government Joint Travel Regulations. Payment for attending additional conferences shall be made after submittal of a separate ENG Form 93, which shall not be assigned a partial payment estimate number.

9. <u>Video Record.</u> The government reserves the right to make a video record of the presentation.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

a. In title block, clearly identify projects as "ECIP."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive listing of buildings, zones, or areas including building numbers, square foot floor areas, designated temporary or permanent, and usage.

d. List references, assumptions and provide calculations to support dollar and energy savings, and indicate any added costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

e. Claims for boiler efficiency improvements much identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

g. An ECIP Life Cycle Cost Analysis Summary Sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in the project. Separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable, and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance dated 10 August 1982 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analysis.

m. The five digit category code number for all ECIP projects developed under this scope of work is 80000.

ANNEX D

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data (types, similar facilities, sizes, etc.).

3. Present Energy Consumption.

   o Total Annual Energy Used.

   o Source Energy Consumption.

Electricity	- KWH, Dollars, BTU
Fuel Oil	- GALS, Dollars, BTU
Natural Gas	- THERMS, Dollars, BTU
Propane	- GALS, Dollars, BTU
Other	- QTY, Dollars, BTU

   o Energy Consumption by Systems.

4. Historical Energy Consumption.

5. Energy Conservation Analysis.

   o ECOs Investigated.

   o ECOs Recommended.

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP Projects Developed. (Provide list)*

   o Non-ECIP Projects Developed. (Provide list)*

   o Operational or Policy Change Recommendations.

* Include the following data from the Life Cycle Cost Analysis Summary Sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. Show the simple payback period for all ECOs.

6. Energy and Cost Savings.

   o Total Potential Energy and Cost Savings.

   o Percentage of Energy Conserved.

   o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

7. Energy Plan.

- Project Breakouts with Total Cost and SIR.
- Schedule of Energy Conservation Project Implementation.

MEETING MINUTES

CLARK, RICHARDSON AND BISKUP
Consulting Engineers, Inc.

2701 ROCKCREEK PARKWAY • SUITE 111 • NORTH KANSAS CITY, MO 64117
TELEPHONE (816) 472-7200 FAX: (816) 472-1385

CRB

October 23, 1989

Department of the Army
Kansas City District, Corps of Engineers
700 Federal Building
601 East 12th St.
Kansas City, Missouri 64106

Attn: MRKED-MF/Robert McCormick

Re: Energy Engineering Analysis for the United States Disciplinary Barracks. Notes from the initial meeting.

Bob,

The enclosed notes are from our first meeting with Ft. Leavenworth personnel where we discussed the procedures required for us to gain and maintain access inside the USDB for the field work required for this project.

I would also like to request the government furnished information outlined on page 16 of Annex B of the scope of work. We would appreciate this information as soon as possible.

If you have any questions please call myself or Gary Transmeier at 472-7200.

Sincerely,

Mark A. Wendland, P.E.
Clark Richardson & Biskup

cc.. Rich Willms - Ft Leavenworth DEH
Tom Lance - Architects Consortium

MEETING NOTES

PROJECT: Energy Survey for the United States Disciplinary Barracks

DATE: October 16, 1989

SUBJECT: Entry Interview

ATTENDING:

Mark Wendland - CRB	Gary Transmeier - CRB
Tom Lance -Architects Consortium	Dave Scott - Architects Consortium
Rich Willms - Ft. Leavenworth DEH	Captain Doane - USDB

Requirements for access to USDB

1. CRB will send names and SS numbers of persons requiring access to the USDB to Rich W. by 10/18/89. Security check is expected to take 10 working days from the receipt of the information.

2. Cameras are allowed in the USDB, however no pictures of inmates are allowed. Rich will explore the possibility of Ft. Leavenworth developing the pictures and clearing them for the A/E's use.

3. Tools are allowed, ie: wrenches, screwdrivers, measuring equipment etc., however they should be kept to the minimum number required for that days work and be in a locked case when they are not in use. Additionally, a property pass will be carried identifying which tools are carried into the USDB so they can be checked out when leaving the facility. The tools will also be engraved or marked with the CRB logo to help identify tools. We understand that if a tool is lost or stolen, we should immediately notify Captain Doane. Ladders can be used inside the facility, however the A/E will need to schedule their use with Captain Doane at least 1 day in advance.

4. Parking and entrance to the facility will be by the west personnel gate. Cars should be registered with the Provo office.

5. Hours of access should be from 8:00 AM to 11:30 AM and from 12:30 PM to 4:30 PM to avoid delays and interference with transfer schedules of inmates working outside the facility. Access at all hours is allowed however the west gate closes at 5:00 PM and the south or main entrance will be used. We do not anticipate needing access other than the hours scheduled.

6. The only holiday that may interfere with the field work, is November 10, 1989, veterans day. We will work around that holiday

7. If an alarm is sounded while A/E personnel are inside the facility, the personnel are to proceed directly to the west gate and will be escorted out of the facility. If exiting at the west gate is not possible, go to Captain Doane's office in building 467. His number is 684-2560.

8. A/E field personnel should stay in pairs and travel with a guard thru maximum security areas. All field personnel will carry a small card identifying the person, describing the project and identifying Captain Doane as our USDB contact to help facilitate the interface between field personnel and USDB personnel.

General Project Information

9. Outside contractor labor rates should be used for all cost estimates.

10. In the medical sections of building 465 equipment shutdowns should be scheduled.

11. A schedule of the areas we intend to survey and the days we will be there will be given to Captain Doane to help identify possible coordination problems with other work in the facility.

12. The kitchen areas are known to have inadequate ventilation. Building 463, (Visitor Center) is also known to be inadequate.

MEETING NOTES:

DATE: 1-29-90

ATTENDING: Dave Anaya - DEH
Fred Murawski - USDB
Mike Mahoney - CRB
Mark Wendland - CRB

SUBJECT: USDB - ECO Development

A list of Applicable Buildings for Each ECO was passed out. (See attached list.) ECO's are divided into Architectural, Mechanical and Electrical classifications. The buildings that applied to each ECO are listed under that ECO. Each ECO was discussed along with the buildings listed under it, .and modifications to the lists were made based on the discussion. ECO's were modified and buildings were deleted and added based on the information from Dave. Anaya. and Fred Murawski.

1. Castle will be considered in terms of ventilation only. No mechanical cooling.

2. Better funding opportunities exist for new work packages with construction costs of less than $200,000. Repair work can go to $2,000,000.

3. The existing Castle is currently being modified. 2 tier (old laundry) will become a craft shop. 3 tier (mess) will be remodeled. All other tier functions will remain.

4. Buildings 465, 474 and Castle have all had new roofs, in the last five years. 6" of insulation was added at that time.

5. The only dock door to consider is on building 470, which is not part of the study. We will still provide an ECO on the door.

6. Window tinting for solar shading ECO is not a security problem.

7. On applicable ECO's separate out the cost of adding prison inmate construction.

8. In some cases avoided costs can be used to improve paybacks. Only if the cost would already have to be incurred by the USDB at some point within the payback period.

9. Use ACA prison standards for minimum ventilation requirements.

10. Buildings 463 and 473 have no warm up capability. Existing systems are to small.

11. Synergistic effects will be modeled for the Final Submittal once the initial savings have been determined for the Interim Submittal.

12. Previous maintenance experience indicates that installing flow restricters and automatic shut off valves are not acceptable.

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TELEPHONE (816) 483-0600 FAX: (816) 483-0111

CRB

DATE: February 14, 1990 **CRB #1496**

LOCATION: Fort Leavenworth

ATTENDEES:

Richard Willms	Fort Leavenworth DEH
Captain Doane	USDB
[redacted]	
Tom Lance	ACI
David Scott	ACI

SUBJECT: USDB Energy Study

ITEMS:

1. ACI gave Captain Doane a sample of the metal clad gypboard that would be used for an interior skin if insulation were added to the castle cell barracks. Captain Doane stated that the metal clad gypboard would only be necessary for the castle cell wings 475C, D, F, G and 475E in the gym and mess hall. The metal clad gypboard is only necessary from the floor to 10'. Above 10' a standard gypboard is sufficient. All other buildings in the USDB that are being considered for wall insulation can have standard gypboard.

2. ACI discussed the replacement of single pane windows with a double glazed window with a better coefficient of heat transfer. Captain Doane stated that some of the buildings in the USDB are considered historical and cannot have any exterior changes made to them. Captain Doane will get a list of the historical buildings to CRB. Richard Willms will get a copy of the window specification presently being used by the Fort Leavenworth DEH to CRB.

3. ACI discussed the use of exterior shading on the windows of the buildings to cut down on the solar load. A low "e" film cover would be acceptable. Only those windows with surfaces facing the sun with a large solar gain need to have the window film installed. The windows facing north do not need the film.

4. ACI showed feasible ideas for vestibules on buildings 463 (south gate) and the castle. Richard Willms stated he would like to see improvements to the existing vestibules in the castle. He also stated he would like to see a revolving door on the south of building 463 and a new vestibule on the north door. Captain Doane stated he would get the bullet resistant glass type requirements for the south door on building 463 to CRB.

5. CRB briefly stated that the base load modeling was completed and that CRB had started writing the ECO reports. Not all of the ECO reports require the use of the computer model for the buildings.

The items listed above represent our interpretation of the meeting events. Please contact Michael Mahoney if there are any additions or revisions to the above items.

Michael J. Mahoney

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